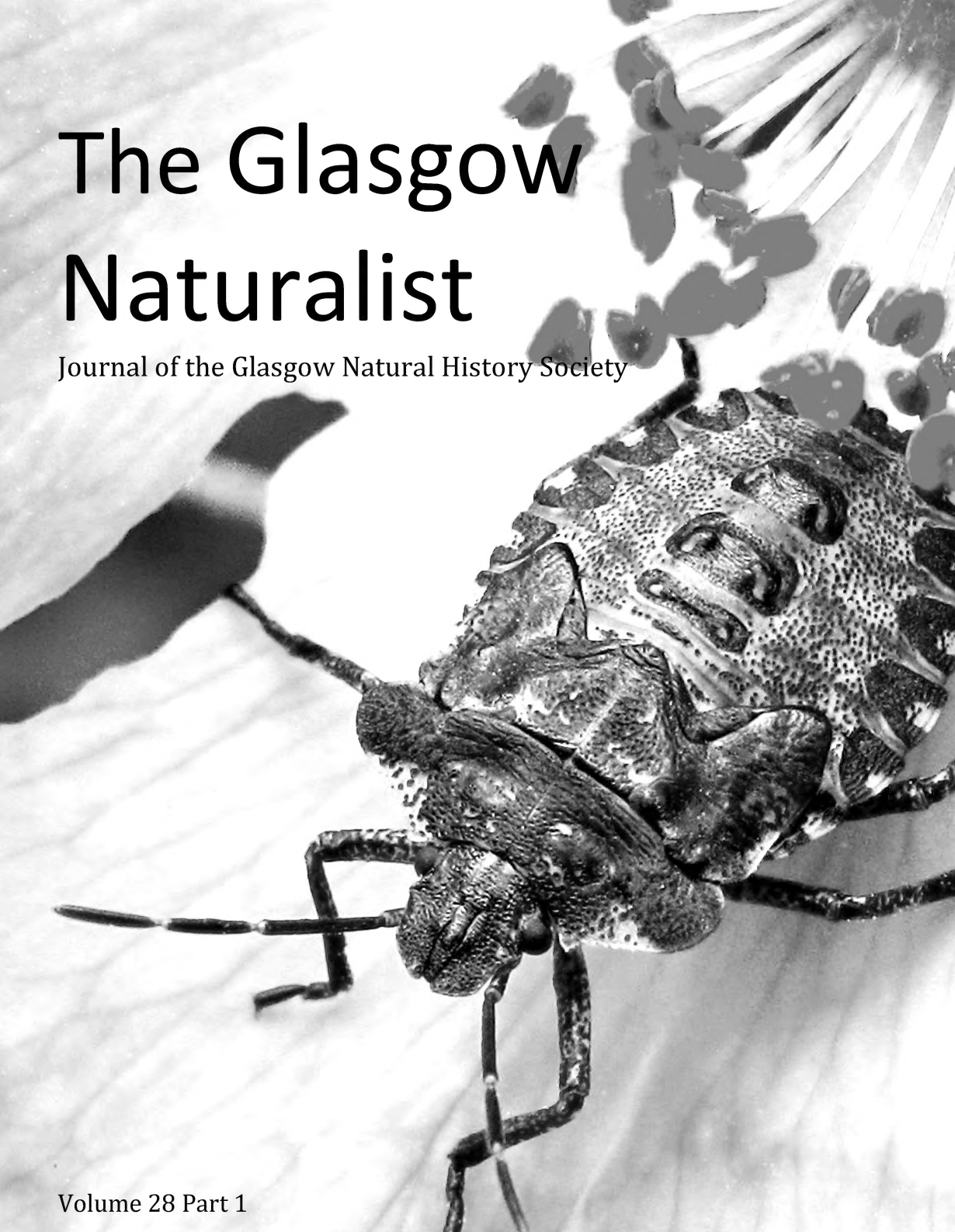
The Glasgow Naturalist

Journal of the Glasgow Natural History Society



Volume 28 Part 1

With Supplement: Proceedings of the GNHS Brownfield Biodiversity Conference, 4th – 5th June 2022

Glasgow Natural History Society

(formerly The Andersonian Naturalists of Glasgow)

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The Glasgow Naturalist

The Glasgow Naturalist is published by the Glasgow Natural History Society ISSN 0373-241X. It was first issued in 1909 and is a peer-reviewed journal that publishes original studies in botany, zoology and geology, with a particular focus on studies from the West of Scotland. Full details of the journal can be found at www.gnhs.org.uk/gnat.html

A digital version of *The Glasgow Naturalist* from 1909 to the present is available at the Biodiversity Heritage Library at www.biodiversitylibrary.org/bibliography/38981#/summary
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Information for contributors is given on the back inside cover of this edition and at www.gnhs.org.uk/documents/gn_advice2021.pdf. For questions or advice about submissions please contact the Editor Dr Iain Wilkie (E-mail: Editor@gnhs.org.uk) Craigeniver, Strachur, Argyll PA27 8BX.

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Front cover Forest shieldbug (*Pentatoma rufipes*), final instar, Staney Brig, Milngavie, East Dunbartonshire, Scotland, 23rd June 2022. (Photo: Sarah Longrigg)

Back cover Przewalski's horse (*Equus ferus przewalskii*), Highland Wildlife Park, Kincraig, Scotland, May 2022. (Photo: Magdalena Butowska)

The Glasgow Naturalist
Volume 28 Part 1

Edited by: Iain C. Wilkie & Christopher J. McInerny

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EDITORIAL

Urban natural history

I.C. Wilkie

School of Biodiversity, One Health and Veterinary Medicine, University of Glasgow, Glasgow G12 8QQ

E-mail: iain.wilkie@glasgow.ac.uk

This is the first part of a new volume of *The Glasgow Naturalist*. An outstanding feature of this issue is the supplement consisting of 14 articles based on presentations at the GNHS Brownfield Biodiversity Conference held in the Graham Kerr Building, University of Glasgow on 4th June 2022. Downie *et al.* (2023) contribute a detailed overview of this conference, which includes the programme and abstracts of contributions that were not written up as articles.

The brownfield articles provide a powerful illustration of the capacity of organisms to recolonise, and restore biodiversity to, previously industrialised land. It is a cause for great optimism that ecosystems can develop once again, even without human assistance, in such apparently inhospitable environments as a former municipal landfill site (Weir & McLaren, 2023) and the location of what had been largest explosives factory in the world (Philp, 2023). Brownfield sites have been described as "oases of urban biodiversity" (Macadam & Bairner, 2012) and are one reason why cities can play a key role in halting and reversing biodiversity loss, which is a theme of the ambitious £10.2M-funded GALLANT project ("Glasgow as a Living Lab Accelerating Novel Transformation") outlined by Dominic McCafferty in Downie *et al.* (2023).

This issue of *The Glasgow Naturalist* is very much dominated by urban natural history: as well as the 14 brownfield articles, seven of the 13 others deal with the wildlife of Scottish cities. The study of urban natural history in Scotland and the rest of the U.K. began in earnest from the middle of the 19th century when an astonishing number of new societies was founded in the rapidly expanding towns and cities: Aberdeen Natural History Association, 1845; Natural History Society of Glasgow, 1851; Edinburgh Naturalists' Field Club, 1869; Dundee Naturalists' Society, 1874; Stirling Field Club, 1878; Belfast Naturalists' Field Club, 1863; Cardiff Naturalists' Society, 1867; Haggerstone Entomological Society, 1858 (which became the London Natural History Society in 1913); and societies in Birmingham, Bristol, Liverpool and Manchester in the 1850s and 1860s (sources listed after *References*). While these societies were responsible for organising the systematic recording of the fauna and flora across the whole of their respective geographical regions, because they were based in towns and cities, this included a wealth of information about nature in urban environments (Goode *et al.*, 2021). This is attested by publications such as *Handbook of the Natural History of Glasgow and the West of Scotland* (Elliot *et al.*, 1901) in which it is acknowledged that the species lists are largely the work of the members of the Natural History Society of Glasgow and the Andersonian Society.

The study of urban natural history has been important in demonstrating how ecosystems and individual species are affected by, and can adapt to, human-induced environmental change. This is typified by the fortunes of the peppered moth (*Biston betularia*). A melanic form of this moth was first discovered in 1848 near the centre of Manchester by R.S. Edleston (1819-1872) - an amateur naturalist and "business man engaged in calico printing" (Cook, 2015). Being better camouflaged on the dark bark of sooty tree-trunks and therefore less vulnerable to bird predation, this form more or less replaced the original lighter form by the end of the 19th century, providing what has been confirmed to be a classic demonstration of natural selection in action (Cook & Saccheri, 2013; McGhie, 2016). Many other examples of urbanisation-driven microevolution have been subsequently identified and investigated (Lambert *et al.*, 2020; Szulkin *et al.*, 2020).

The study of urban natural history has also revealed how human activities can bring about faunistic and floristic change in unexpected ways. The lichen *Lecanora conizaeoides* provides a good example of this. It is suspected that the original habitat of this lichen is the acidic bark of dwarf mountain pines (*Pinus mugo*) growing in Central European bogs (Massara *et al.*, 2009). It was very rare or not present in Britain before the middle of the 19th century. The first British records are from England - Epping Forest, New Forest and Derbyshire (Crombie, 1885). Thereafter, it spread throughout the industrialised regions of the British Isles, becoming abundant, and often the only lichen, in urbanised areas, including Glasgow. This success resulted from the ability of *L. conizaeoides* to thrive on substrates acidified by the then dominant air pollutant - sulphur dioxide - and take advantage of the lack of

competition that followed the elimination of sulphur dioxide-sensitive lichens. However, over the past 20-30 years it has declined dramatically across the U.K. and Europe and is now rare in Glasgow (Wilkie, 2021). This has been attributed to an increase in bark pH due to a combination of the reduction in sulphur dioxide emissions that followed the Clean Air Act of 1956 and rising emissions of ammonia originating from the catalytic convertors of road vehicles (Bates *et al.*, 2001; Massara *et al.*, 2009).

It has been estimated that around 3% of the world's total land area is already urbanised (in the broad sense that includes vegetated areas such as parks and gardens) (Liu *et al.*, 2014). Seto *et al.* (2011) calculated that the average annual urban expansion growth rate ranges from 2.5% (Europe) to 7.5% (China), which may result in the global total amount of urban land increasing by a factor of 2-6 over the 21st century (Gao & O'Neill, 2020). Urban natural history can only become increasingly relevant with time.

For those wanting to learn more about the subject, I can recommend Shirley (1996; still available via online purchase) as a general introduction and Sutcliffe (2010), which includes succinct accounts of wildlife sites within the Glasgow boundary.

This issue of *The Glasgow Naturalist* includes the obituary of Peter Meadows written by Roger Downie. Peter Meadows was co-editor (with Azra Meadows) of the journal from 2002 to 2007, during which time the four parts of Volume 24 were published. I first encountered Peter Meadows when I was a second-year B.Sc. Zoology undergraduate at the University of Glasgow and attended his course on "Invertebrate phyla" in which he covered the full spectrum from Protozoa to Chordata. This being 1969-70, there were no handouts, and we all assiduously copied his many blackboard drawings, some quite elaborate; my notes are peppered with references to page numbers in E.J.W. Barrington's (1967) *Invertebrate Structure and Function*, although I neglected to record his anecdotes about Jamaica, from where he had recently returned after a sabbatical. I am indebted to him for stimulating an interest in invertebrates, which developed into a research obsession that continues undiminished to this day.

ACKNOWLEDGEMENTS

I am very grateful to Chris McInerny, Ruth Maclachlan and Richard Weddle for their assistance in the editing, assembly and website presentation of the journal, and to Roger Downie and Richard Weddle for the main editing of the Brownfield Biodiversity Conference proceedings. Thanks are due also to Tony Payne for dealing with the book reviews and to the external experts whose critical evaluation of submitted manuscripts is crucial in maintaining the journal's scientific standards. The external reviewers for this issue were (in alphabetical order): C.E. Adams, S. Angus, C. Cathrine, M. Culshaw, R.W. Furness, J.T. Høeg, L.A. Lawton, B. Rowson, R. Sutcliffe, R. Watling and R.B. Weddle.

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SOURCES OF INFORMATION ON NATURAL HISTORY SOCIETIES

(All accessed 2nd April 2023.)

Aberdeen	https://discovery.nationalarchives.gov.uk/details/c/F97040
Dundee	https://dundeenaturalists.org.uk/
Edinburgh	http://www.edinburghnaturalhistorysociety.org.uk/about.php
Glasgow	https://www.glasgownaturalhistory.org.uk/history.html
Stirling	https://www.stirling-lhs.org/11th-november-1878.html
Belfast	http://www.bnfc.org.uk/
Cardiff	https://cardiffnaturalists.org.uk/htmfiles/history.htm
Haggerstone	https://www.lnhs.org.uk/index.php/about-us/history
Birmingham	http://bnhsoc.org.uk/
Bristol	https://bristolnats.org.uk/
Liverpool	https://www.liverpoolmuseums.org.uk/artifact/liverpool-naturalists-field-club
Manchester	http://www.manchestermicroscopical.org.uk/mmshist.html

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FULL PAPERS

Update on incidences of cyanobacteria (blue-green algae) in Scottish freshwaters

J. Krokowski

Scottish Environment Protection Agency, Ecology Assessment Unit, Eurocentral, Holytown, North Lanarkshire ML1 4WQ

E-mail: jan.krokowski@sepa.org.uk

ABSTRACT
An update on incidences of cyanobacteria (blue-green algae) in Scottish freshwaters is provided, highlighting the number of incidences and common cyanobacteria taxa recorded, and outlining potential effects of climate change on future bloom events.

INTRODUCTION
This article aims to provide an update to a previous review from the Scottish Environment Protection Agency (SEPA) on incidences of cyanobacteria (blue-green algae) in surface waters in Scotland (Krokowski *et al*., 2012).

Cyanobacteria (blue-green algae), but specifically the toxins cyanobacteria can produce, continue to pose a significant risk to water users, and to a wide range of animals that come into contact with blooms and scums (Svirčev *et al*., 2019). Exposure to these cyanotoxins has adverse health effects on animal and human health, and details are widely available for monitoring of cyanobacteria (Meriluoto *et al*., 2017) and management of incidents in recreational and drinking waters (Chorus & Bartram, 1999; Chorus & Welker, 2021). In most cases people who encounter potentially toxic cyanobacterial blooms and scums often report skin rashes, eye irritations, vomiting and diarrhoea, fever, and pains in muscles and joints. There are, however, many regional and worldwide reports and incidents annually of dead or ill animals associated with potentially toxic cyanobacterial blooms, scums and mats, in some cases resulting in the death of a range of wild animals, pets and livestock, and in rare cases humans (Wood, 2016).

Cyanobacteria are ubiquitous. An interplay of many complex factors affects their frequency and distribution in freshwaters. A supply of nutrients, mainly phosphorus (P) but also nitrogen (N), and light is a prerequisite, with highest growth rates shown under relatively warmer periods and under favourable hydro-physical conditions of the waterbody (Elser *et al.,* 1990). Several adaptive features allow cyanobacteria to dominate over true algae (Fogg, 1969). Specific studies across European and U.K. lakes (Carvalho *et al.,* 2013) demonstrated cyanobacteria to be more abundant in clear (10-20 Pt l^{-1}), neutral to alkaline waters (>1 mEq l^{-1}) with relatively long retention time (>30 days), with their biggest increase in abundance posing greatest risk where total phosphorus (TP) concentrations in waterbody are between 20-100µg l^{-1} TP.

Cyanobacterial blooms are, however, recorded more frequently in freshwaters due to increasing anthropogenic eutrophication (Huisman *et al.,* 2018), and increasingly due to changes posed by climate change (O'Neil *et al.,* 2012). Climate change is exacerbating the risks and impacts of freshwater eutrophication with increasing blooms of cyanobacteria becoming more likely (Wagner & Adrian, 2009) and is predicted to further increase the frequency and duration of cyanobacterial blooms regionally and worldwide (Jones *et al*., 2020). An increase in recreational use of waters by public and increasing awareness of blooms also brings the public into closer contact with cyanobacteria.

UPDATE
Climate change and cyanobacteria in Scotland
There is evidence for an association between climate change and outbreaks of cyanobacterial blooms in Scotland. Data from the Met Office (Metoffice.gov.uk, 2022) highlighted increasing mean air temperatures across the whole of Scotland, with a 0.1°C increase in 2021 compared with the 1991-2020 average. Northern and western areas were also sunnier than average, with sunshine duration 105-115% higher than the 1981-2020 average, with the western half of Scotland also drier than average in 2021, with rainfall 105-135% higher across most of the rest of Scotland compared to the average over the 1981-2010 period.

It is difficult to ascertain changes in algal and cyanobacterial concentrations across the 25,615 fresh waterbodies in Scotland with surface area greater than 0.01 km^2 (Hughes *et al*., 2004), but a few case studies highlight a spread in geographic distribution and an increase in frequency and duration of algae and cyanobacteria. The water-net, green alga *Hydrodictyon reticulatum* had a most northerly record in Strathclyde Loch, potentially in response to increasing temperatures and nutrient concentrations (McManus, 2012). An

increase in cyanobacteria was correlated with climatic factors and increasing nutrient inputs in Loch Leven (May *et al*., 2012), and seasonal and temporal changes in phytoplankton were shown in Loch Flemington (Lang *et al.*, 2016).

Utilising SEPA data from 142 lochs and reservoirs monitored between 1989-2018, May *et al*. (2022) predicted increased development of algae and cyanobacteria in response to climate change, specifically increasing air and corresponding water temperatures and increased nutrient inputs. Water temperature increases were 0.25-1.0°C per year for most of the lochs over the period, with cyanobacterial blooms specifically shown to increase where monthly water temperatures exceeded 17°C. Knock-on effects across the freshwater communities at shorter and longer timescales were highlighted, threatening loss in biodiversity and causing phenological changes across food-webs. Modelling showed a corresponding rise in water temperatures by 3°C in Scottish lochs over the period 2020-2080, with most impacts (increasing algal and cyanobacterial concentrations) likely to affect shallow (depth 3-15 m) and very shallow (depth <3 m) waterbodies, and those of medium alkalinity (200-1,000 µEq l^{-1}), where management action should be focused (May *et al*., 2022).

SEPA and cyanobacteria

SEPA provide scientific information and advice to help support the public and public health bodies in keeping people and livestock safe from potentially toxic algal blooms in lochs, reservoirs, and rivers. SEPA provide advice and assistance in analysis of *ad hoc* samples from suspected cyanobacterial blooms in recreational waters following the Scottish Government guidance (Ramsay *et al*., 2012), based on the World Health Organisation guidance on assessment and minimisation of risks to public health (Chorus & Bartram, 1999; Chorus & Welker, 2021).

Cyanobacteria incidents in Scotland

In the period 2008-2010 SEPA analysed 130-181 water samples per year that were received in response to visual algal problems in lochs, rivers and reservoirs (Krokowski *et al.,* 2012). Results indicated that 35-54% samples were reported to contain cyanobacteria at concentrations exceeding set thresholds as set out in the Scottish Government guidance to minimise risks to public health (concentrations in excess of 20,000 cyanobacterial cells ml^{-1}).

In subsequent years, the number of reports and samples analysed and reported by SEPA varied with blooms generally reported in the same waterbodies year after year with most reports increasing from May onwards and concentrated during the summer and autumn periods. Reports are however not uncommon during the winter months. In general, approximately one third of all samples had cyanobacteria in excess of the 20,000 cyanobacterial cells ml^{-1} threshold (Fig. 1).

In 2014 there was a significant increase in samples analysed and reported by SEPA due to the Glasgow Commonwealth Games, with a significant number of samples analysed from recreational waterbodies at regular frequency throughout the year, the numbers of which more than doubled compared with previous years (Fig. 1). By 2018 and 2019, the number of samples analysed was similar to that from the late 2000s and early 2010s. In 2019, SEPA received nearly 300 samples of which only 48 were reported to exceed the threshold of 20,000 cyanobacterial cells ml^{-1} set by Scottish Government (the lowest proportion as a total of all samples since 2008).

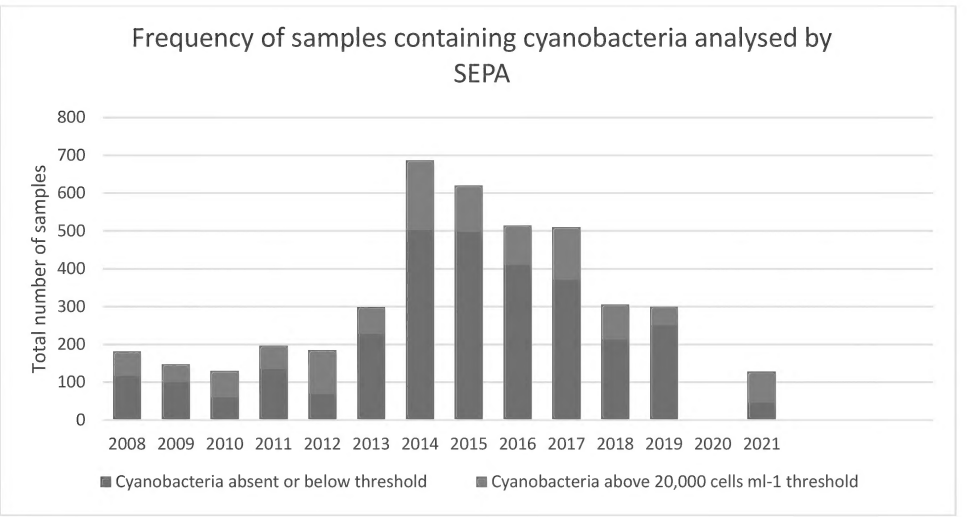

Fig. 1. Number of algal samples analysed by SEPA showing percentage where cyanobacteria were absent or below the 20,000 cells ml^{-1} threshold, and where cyanobacteria exceeded the warning threshold.

There were no records available for 2020 during the time of the COVID-19 pandemic. In 2021, SEPA received 128 samples, the lowest number since 2008 but with the highest proportion of samples found to exceed the 20,000 cyanobacterial cells ml^{-1} threshold. This may be attributed to the period following COVID lockdowns with access to recreational waters and limited office accessibility for staff to sample and analyse samples, with the majority of samples sent for analysis containing visual cyanobacteria and fewer samples containing non-cyanobacteria. There were at least two separate events in July 2021 where reports of the death of dogs were associated with high concentrations of cyanobacteria in Pollok Park, Glasgow, and Loch Airigh na Lic, Stornoway, Isle of Lewis, with other unsubstantiated reports, for which no analyses were possible, of swimmer's itch in Loch Lomond and Loch Ard, Stirlingshire, and reports of dead birds in Carron Valley reservoir, Stirlingshire and Linlithgow Loch, West Lothian.

Data continue to be subjective as only sites with perceived or visual algal or cyanobacterial problems were investigated. Sites where perennial cyanobacterial blooms were present may not have been monitored, in such cases notices were erected warning the public of the risks posed by cyanobacteria without the need to analyse samples. Fig. 2 illustrates typical cyanobacterial blooms.

Common cyanobacteria taxa

Cyanobacteria are very morphologically diverse, with approximately 370 freshwater cyanobacteria species in the British Isles (Whitton *et al.*, 2014). Their nomenclature is dynamic and relies on morphological and ecological features, and more recently changes have occurred using molecular phylogenomic approaches for identification (John *et al.*, 2011, 2022), with a polyphasic concept adopted (Komárek, 2013). Using the recent and widely adopted nomenclature (Meriluoto *et al.,* 2017; John *et al.*, 2022) the commonest cyanobacteria taxa routinely detected continue to belong to genera of *Aphanocapsa*, *Anathece*, *Microcystis*, *Woronichinia*, *Planktothrix*, *Dolichospermum*, *Aphanizomenon* and *Gloeotrichia*. There have been no new records or unusual taxa recorded for Scotland since the last update (Krokowski *et al.*, 2012), and recent records for new taxa recorded in the British Isles are detailed by John *et al.* (2022). These are potentially all toxin-producing taxa, but with more than 100 cyanobacteria species and genera producing toxins (Meriluoto *et al.,* 2017), the list of taxa is not exhaustive as new toxin-producing taxa are likely to be identified in the near future.

Management of cyanobacteria

There are several viable methods and techniques for managing and reducing algae and cyanobacteria in waters, but it is beyond the scope of this article to extensively discuss them. Primarily, aggressive reduction in nutrient inputs to waterbodies and P in particular must happen to reduce algal and cyanobacterial growth, as P appears to be the nutrient controlling most waterbody productivity. Even then, there is very strong chance that cyanobacteria will return, as other unknown factors may have affected the phytoplankton community structure (Ouellette *et al.*, 2006). Waterbodies may also be N-limited, or co-limited with N and P or other nutrients, and/or light limited, so there needs to be a sound ecological understanding of

Fig. 2. Examples of cyanobacterial blooms in North Lanarkshire, Scotland. (A) Banton Loch, August 2021. (B) Strathclyde Loch, September 2021. (Photos: SEPA)

the waterbody. Ultimately, management should focus on reducing both N and P external inputs. External inputs of P are easier to manage than those of N, but the role of sediments in nutrient release should not be discounted. These may also be a main source of nutrients (P) even when all direct point and diffuse sources have been reduced.

Internal P control may be carried out through sediment removal, sediment treatment with P-binding agents and suppressing P-release from sediment surface through the use of chemical compounds. Such measures may supress internal P loading where sediments are a major source of P but should be used alongside other measures to reduce cyanobacteria and improve water quality (Mackay *et al.,* 2014).

The use of other chemical controls to lyse cyanobacterial cells or inhibit their growth will require approval and expert guidance for use on or near water, since during lysis cyanotoxins may be released. Hydrogen peroxide has been shown to be selective in suppressing cyanobacteria and has the advantage in that it quickly degrades to water and oxygen (Matthijs *et al.*, 2012; Barrington *et al.*, 2012), and was one of a number of measures used in Strathclyde Loch to abate cyanobacteria in a section of the loch used for swimming events (SNIFFER, 2013).

Biomanipulation through enhancing loss rates of cyanobacteria or supporting their predators to reduce phytoplankton abundance is a well know intervention measure (Jeppesen *et al.*, 2012), and has been shown to be most effective in smaller waterbodies where a reduction in phytoplankton and cyanobacteria may occur only below a threshold of P-loading. The use of other biological control interventions such as using barley straw is variably effective and again only in smaller waterbodies (Ball *et al.*, 2001).

Other measures to suppress growth and dominance of cyanobacteria over other phytoplankton through artificial destratification (water mixing) are effective in relatively deeper waterbodies. Reducing water retention time is also a measure to reducing amount of time cyanobacteria spend growing and is effective in reducing their biomass.

Techniques such as sonication may be costly and impractical in larger waterbodies and it has not been demonstrated that they are effective and practical over the long-term (Rajasekhar *et al.*, 2012). Similarly, the use of dyes and use of shading and shade-balls in an attempt to reduce cyanobacteria have not been fully evaluated, and are costly and controversial (Martínez-Espinosa, 2021).

Recording of incidents

As described, SEPA provided a robust and efficient service responding and analysing algal incidents. It is anticipated that requests for analysis will increase as the effects of climate change lead to an increase in frequency and duration of cyanobacterial blooms, and an increase in water-based recreational activities (May *et al.*, 2022). SEPA are therefore investigating and working towards providing an even more enhanced and robust monitoring and analytical service as effects of climate change lead to more cyanobacterial incidents, working closely in partnership with internal colleagues, as well as with external colleagues, including Local Authorities.

To assist and provide a rapid and more comprehensive picture of harmful algal blooms across Scottish waters, a *Bloomin' Algae* app developed by the U.K. Centre for Ecology and Hydrology can be downloaded and used to report harmful algal and cyanobacterial blooms. Using the citizen science app is quick and easy, and helps inform SEPA, the Local Authority or the landowner of potential public health risks, and, if needed, provides an early warning to the public. The *Bloomin' Algae* app is available from Google Play or App Store (search for "Bloomin' algae").

CONCLUSION

There is no silver bullet that will reduce potentially toxic cyanobacterial blooms in freshwaters, with a site-specific approach required to manage and control cyanobacteria on an individual basis. As there are likely to be continued reports of harmful algal and cyanobacterial blooms across Scottish lochs, recreational waters and reservoirs, work continues by SEPA and others within the river basin management plan (RBMP) which sets out a framework for protecting and improving the benefits provided by the water environment across Scotland (SEPA, 2021).

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The Blodwen Lloyd Binns Bequest: three decades of major positive impacts on Glasgow Natural History Society

J.R. Downie*, R.B. Weddle, S. Futter & B.K. Mable

Glasgow Natural History Society, c/o Graham Kerr building, University of Glasgow, Glasgow G12 8QQ

*E-mail: roger.downie@glasgow.ac.uk

ABSTRACT

The establishment of the Blodwen Lloyd Binns (BLB) Bequest in 1991 and the transformative impact of its first 20 years on the development of Glasgow Natural History Society have previously been reported. This paper describes the following decade, up to 2022. BLB's requests, including publication of a biography of John Scouler and floras of Renfrewshire and Lanarkshire have been carried out. Sadly, Peter Macpherson, author of the Lanarkshire flora, died before publication of his book. The overall capital value of the Bequest has been maintained, and supplemented in the last decade by additional legacies and donations. The income generated has been used to fund a wide variety of natural history projects: publication of *The Glasgow Naturalist* and several books, a BLB prize and lecture series, the organisation of several conferences, bursaries to help young scientists learn identification and recording skills, and funding of a wealth of public engagement and research work, including student expeditions and tools to help communities appreciate local biodiversity. Although the COVID-19 pandemic curtailed some work normally funded by the Bequest, the lack of funding applications allowed strengthening of the Bequest's capital through re-investment. The future positive impact of the Bequest on the Society's activities looks secure.

INTRODUCTION

As previously recounted by Macpherson (1992), Downie (1998) and Downie *et al.* (2012), in 1993 Professor Blodwen Lloyd Binns (BLB) left a substantial legacy (hereinafter the Bequest) to Glasgow Natural History Society (GNHS) in her will, with no conditions, but a set of suggestions on how the Society might use the money. The Society's Council established a sub-committee (hereinafter the BLB Executive), which engaged a broker to advise on investment of the legacy, and also drew up a set of uses to which the income generated could be put, with the general policy being to maintain the initial value of the Bequest (£175,000). Downie (1998) described the first five years of the Bequest, and Downie *et al.* (2012) showed how the Bequest's contributions had developed over the first 20 years. Here, we take the story further by recounting the impacts of the Bequest's third decade, including significant changes that have occurred in recent years.

Within the first 20 years, the composition of the BLB Executive and its pattern of meetings (three times each year) were established. In addition, it was agreed that several uses of the income needed no specific application to the BLB Executive. These are:

- A contribution to the social life of the Society, in accordance with one of BLB's express wishes. This includes paying for the pre-talk meal that speakers enjoy in the company of Society members.
- Support for the publication of the Society's journal *The Glasgow Naturalist* to help it achieve and maintain high-quality production standards. This includes printing and administrative costs, and the addition of DOIs to all published papers. In 1978, the new editor, Eric Curtis (Anonymous, 1977), highlighted the financial strain on a small natural history society of publishing a scientific journal on an annual basis. The problems were the rising costs of printing and the low rate of manuscript submission by members (Downie & Tait, 2001). BLB funding has solved the cost problem, and by making the journal more attractive to authors has helped with the submission issue.
- Funding for an annual prize awarded to the author of the best paper published in *The Glasgow Naturalist* by an author new to scientific writing.
- Funding for the annual BLB lecture, established in 2001.
- Funding for a joint GNHS/Biological Recording in Scotland (BRISC) bursary scheme (see section on **Recording** below).

Other uses of the income are dependent on applications to the BLB Executive, using an on-line form developed by the Executive. Following experience, the criteria and conditions for support have been refined over the years (GNHS, 2023) and currently are:

- Funds are available to individuals and groups for assistance in carrying out projects of natural history interest.
- Since a decision of January 2019, applicants must be members of the Society. Student applicants must be supported by a letter from their supervisor.

- Where a decision needs to be taken over the merits of competing applications, preference is given to local over distant projects, and to projects likely to generate future publications (either in *The Glasgow Naturalist* or elsewhere). Grants are not generally given to cover salaries.
- The Executive may make project awards of up to £2,000, but must seek the approval of GNHS Council for awards greater than £2,000.
- In addition to supporting natural history projects of Scottish interest, the Executive will consider: a) support for overseas student expeditions from west of Scotland universities (up to £1,000 per expedition); b) support for the costs of undergraduate research projects in the U.K. (up to £200 per project); c) support for overseas natural history research by individuals (up to £600); d) support for postgraduate students to report the results of their natural history research at international conferences.
- Once a project has been completed, a report should be sent to the Secretary of the Society. Reports, or summaries of them, are published in the Society's newsletter.

In the following update of the BLB Bequest's impacts, we essentially follow the order of topics covered by Downie *et al.* (2012) for ease of comparison.

UPDATE

Management of the Bequest

The Bequest's management procedures have undergone minor changes in the last few years. The BLB Executive now meets in February, May and September to fit with the financial reports provided by the Society's investment managers. The grant application form has been revised, including requiring all applicants to be Society members. The Executive is chaired by a Convenor and includes the General Secretary, Treasurer, the President (or a vice-President), scientific and financial advisers. The most momentous recent change has been the retirement of Peter Macpherson from the Executive in March, 2015. Peter had been a scientific adviser to the Bequest Executive since its inception and had been the Society's closest link to Professor Lloyd Binns (as described in Macpherson, 1992 and Downie *et al.*, 2012). Sadly, Peter died, aged 89, soon after his last Executive meeting, on 24th March, 2015 (obituary: Dickson, 2017).

The Bequest's finances

Downie *et al.* (2012) detailed the changes in the market value of the Bequest's holdings over the first 20 years. The value of the original Bequest when it was first invested in 1993 was £175K. At the 2022 AGM, the value reported was £402.7K. We checked two sources of inflation estimates for the period 1993-2022. The first (Inflation Tool, 2023) gave the purchasing power of £175K in 1993 in 2022 money as £345.7K, and the second (Composite Price Index, 2023) as £456.8K. The difference results from using somewhat different criteria to calculate inflation. The fact that the reported value of the BLB Bequest's holdings falls between these two estimates suggests that the aim of maintaining the value of the Bequest has been attained, though we should add that the policy has been assisted by two factors: a) grant applications fell during the two years of the COVID-19 pandemic, allowing most of the income to be re-invested; b) the Bequest was topped up by additional income: legacies of £25K from Peter Macpherson – much of it used to fund his *Flora of Lanarkshire* and to catalogue his herbarium as described below (**Journal and other publications**), and £10.6K from Ann Christine Flum (born in Kirkintilloch, she lived most of her life in California, but retained links with Scotland, and established a trust which donated to many Scottish organisations on her death); also donations totalling £1K were received to help with publication of the *Flora of Lanarkshire*.

The total income generated by the Bequest's investments 2011-2021 was £167.8K, £15.3K per year, of which 84.6% was spent on grants and 6.1% on administration (financial managers' fees). By comparison, Downie *et al.* (2012) reported income of £226.6K over the 17 years 1994-2010, £13.3K per annum. Given inflation between these two time periods, these data suggest that the income generated now is a little less in purchasing power than in the earlier period.

The different purposes supported by grants are shown by percentage in Table 1. U.K. research and student expeditions top the list. It is good to see a substantially higher proportion of grants going to U.K. research than in the earlier period (39.8% cf. 19.8%). The proportion going to publications would be higher if the *Flora of Lanarkshire* had been included, but this was funded primarily through the Macpherson legacy.

Purpose	Percentage of total grant expenditure
Conferences	3.2
Habitat work	8.0
Training courses	5.4
Student expeditions	29.6
U.K. research	39.8
Overseas research	5.8
Publications	10.2

Table 1. Proportions of total by the BLB Bequest grant income, 2011-2022, allocated for different purposes.

Activities supported by grants

As noted above, the top categories for grant support have been U.K. research, student expeditions (below: **University of Glasgow staff-student expeditions**), publications (below: **Journal and other publications**) and habitat work. We make no attempt here to catalogue all the work supported, but instead pick out some examples to demonstrate the diversity of projects that have been made possible by BLB Bequest support.

Habitat work supported has included: pond creation by the U.K. charity Froglife; the deployment of biohavens

on Hogganfield Loch by Friends of Glasgow's Local Nature Reserves - these providing safe nesting surfaces for great crested grebe (*Podiceps cristatus*); the siting of a sand martin (*Riparia riparia*) nesting wall beside the River Kelvin at Garscube estate by the University Campus Biodiversity Group. U.K. research projects supported by the Bequest have mostly been in Scotland, but some have extended further. The Scottish projects include biodiversity surveys on Mingulay and Orkney, reptile ecology at Loch Lomond, the arachnids of the Glasgow Necropolis, and the impacts of offshore wind farms on bird migration. An unusual supported application came from a school leaver, Leif Bersweden, who wished to spend his "gap year" photographing every U.K. orchid species in flower: he later gave us a talk on the (successful) project, and wrote a book about it; he has since completed two degrees in plant science. Another unusual supported application came from a musical duo, "High Heels and Horse Hair", who were developing pieces about British wild flowers for educational performances to local schools. The Bequest has also funded natural history resources. For example, the Lochwinnoch-based charity Eadha grows tree seedlings, especially aspen (*Populus* sp.), for conservation planting; after vandals burned down their polytunnel, the Bequest helped fund a replacement. Another example has been support for the cataloguing and digitisation of the late Charles Palmar's vast collection of photographic slides, based on his field observations of Scottish birds and other wildlife.

Journal and other publications (including prizes for new authors)

The BLB Bequest has continued to be vital for the publication of the Society's journal, *The Glasgow Naturalist* (*TGN*) which has appeared annually over the last decade. *TGN* is published both online (as papers are accepted) and as hard copy once an issue is complete. Annual costs, including printing, postage and preparation are £2,000 - £3,000. In addition to standard papers, short notes and book reviews, *TGN* has published several conference proceedings (see **Conferences** below) and a set of special features on the biodiversity of Glasgow Botanic Gardens (volumes 27(1) - 6 papers; 27(3) - 8 papers; and 27(4) - 4 papers). A major advance in 2019 was registration of *TGN* to be assigned digital object identifiers (DOI) for each article, to increase visibility and online access. Older articles have also been digitised and publications since 1910 are available on the Biodiversity Heritage Library website (accessible via the GNHS website). The Bequest has also supported the production of four books in the last decade, published either by the Society or by other publishers with financial input by the Bequest. These are Nelson (2013), Watson (2013), McInerny & Minting (2016) and Macpherson (2016).

Peter Macpherson was a major contributor to *The Changing Flora of Glasgow* (Dickson *et al.*, 2000), which had received substantial BLB Bequest support, and he also enthusiastically supported a BLB grant to aid the publication of *The Flora of Renfrewshire* (Watson, 2013). Peter, as plant recorder for Lanarkshire (VC77) for 35 years had been working on a Flora of Lanarkshire for decades. As the work neared completion, the BLB Executive discussed what support it could give. Peter was keen that the publication should be of a high standard, requiring substantial funding. The Executive agreed that this accorded with BLB's general wishes, and that, if necessary, some of the Bequest's capital could be used. Peter died before this decision could be put into effect, and it turned out that he had left a substantial legacy to the Society (£25,000), with the request that this be used to bring his Flora to publication and to catalogue his large herbarium so that it could become part of Glasgow Museums' collections. It turned out that there was considerable work needed to convert Peter's detailed records into text and maps. This was undertaken by Keith Watson and Peter's daughters, who had often helped with his fieldwork. Peter had arranged that Pisces Publications should be the publishers, and the book was launched at a special meeting of GNHS in the Bower (Botany) Building of the University of Glasgow in September, 2016. In April, 2017, a sessile oak (*Quercus petraea*) was planted on the University of Glasgow main campus (grassy slope on the north side) and dedicated to Peter in a ceremony attended by family members and GNHS representatives.

As reported by Downie *et al.* (2012), since 2008, a BLB prize has been awarded to the best paper published in any year's *TGN* by an author new to science writing. Since 2011, the prizes have been awarded to Jennifer Dodd for Dodd (2014), Suzanne Bairner for Bairner (2016), Martina Quaggiotto for Quaggiotto *et al.* (2017), in 2018, jointly to Lynsey Harper for Harper *et al.* (2018) and Crinan Jarrett for Jarrett *et al.* (2018), in 2019, jointly to Robyn Stewart for Stewart *et al.* (2019) and Baptiste Wijas for Wijas *et al.* (2019), Alex Fitzpatrick for Fitzpatrick *et al.* (2020), then Anna Acsai and Tamas Drexler jointly, who both contributed to Acsai *et al.* (2021). No award was made in 2022.

Conferences

Downie *et al.* (2012) noted that the organisation of conferences had been a rare activity for the Society prior to the existence of the BLB Bequest. They listed four conferences between 2001 and 2010 all with proceedings published in *TGN*. Since then, there have been four more conferences, with a further one currently being planned (Table 2). All have been organised as contributions to the annual Glasgow Science Festival which occurs in June. In addition, the 2013 conference was selected as a component of the British Ecological Society's nationwide centenary Festival of Ecology. BLB funding, along with additional grants, has allowed conference registration and light refreshments to be free to all participants. In all cases, conference proceedings have been published in *TGN* (Table 2). Conferences have been well attended and help raise the profile of the Society. Occurring late in the COVID-19 pandemic, the 2022 conference was organised as a "hybrid", with one speaker and some other participants contributing remotely, using the online platform Zoom.

Year	Conference Title	Publication of Proceedings
2013	Natives, aliens and re-introductions	*TGN* 26(1): 2014
2015	The River Kelvin: history and natural history	*TGN* 26(4): 2017
2018	The Amphibians and Reptiles of Scotland	*TGN* 27 (supplement): 2018
2022	Brownfield Biodiversity	*TGN* 28(1): 2023
2023	Amphibians and Reptiles (full title pending)	?

Table 2. Conferences supported 2012-2023 by the BLB Bequest, including issue numbers of proceedings published in *TGN*.

Recording

As mentioned above (**Journal and other publications**), recent issues of *TGN* have reported the outcome of surveys for various taxon groups in Glasgow Botanic Gardens (GBG). The most recent survey covered the years 2018-22 and was entitled "On the Wildside Revisited" as it was essentially a repeat of "On the Wildside" in the late 1990s, which had been reported in *TGN* 23 parts 3 (1998) and 4 (1999). The number of taxonomic groups and species recorded in the Gardens was greatly increased by the new surveys, and included some historical records not included in the earlier survey: the comparison between the two sets of surveys is analysed in some detail by Weddle & Downie (2021).

The records from the GBG surveys, together with those underlying the floras by Dickson *et al.* (2000) and Watson (2013), have been incorporated in the database of Glasgow Museums Biological Records Centre; it is expected that further records from Macpherson (2016) will be added in due course.

As there were fewer applications to the BLB Bequest for grants during the COVID-19 lockdowns, the committee introduced a new category: community groups were invited to apply for grants of up to £2,000 towards surveying equipment. Four groups successfully applied: Grow 73 (Rutherglen), Friends of Holmhills Community Woodland, Cashel Woodland Ecology Group and the Hamiltonhill Claypits Ecological Working Group.

We have also continued to offer four bursaries annually towards training courses in natural history field studies, as part of a scheme run jointly with BRISC (Biological Recording in Scotland). These bursaries are open to anyone living in Scotland wishing to improve their skills and contribute to biological recording. Such courses were disrupted by the lockdowns, but have otherwise all been taken up. For the 2022-23 tranche the maximum grant was increased from £300 to £400 to include a maximum of £100 towards travel expenses, in recognition of the fact that there are now fewer courses available in Scotland than elsewhere in the U.K.

University of Glasgow staff-student expeditions

As reported by Downie *et al.* (2012), a regular feature of BLB grant funding has been the support of University of Glasgow Exploration Society overseas expeditions, most of which have a natural history focus. This has continued with the welcome change that, since 2014, one expedition each year has been to a fairly remote Scottish location (so far, Islay or Harris). In the nine years 2011 to 2019, BLB supported 62 expeditions (average of 6.9 per year), with grants averaging £642. No expeditions occurred in 2020 because of the pandemic, and only two were possible in 2021 (to Iceland and Loch Sween, Scotland): thankfully, a full complement of expeditions took place in 2022. Downie *et al.* (2018) discussed the contributions these expeditions have made to natural history knowledge. Although each expedition produces a final report of their findings, and many final year undergraduate research projects are carried out on expeditions, it is a matter of some regret that the expeditions to Scottish locations have not so far resulted in any publications in *TGN*.

Blodwen's requests

Downie *et al.* (2012) provided a full list of Blodwen's requests - her suggestions for how her Bequest might be used - and reviewed progress so far. At that time, the main outstanding items were the floras of Renfrewshire and Lanarkshire, and Scouler's biography. As noted above (**Journal and other publications**), the two floras were published as Watson (2013) and Macpherson (2016). The Scouler biography was published as a supplement to *TGN* (Nelson, 2013) and launched through a lecture given by Charles Nelson on 5th June 2015. Downie *et al.* (2012) noted that Blodwen had planted a specimen of Scouler's willow (*Salix scouleri*) in the arboretum of Glasgow Botanic Gardens in 1988. The current Curator of the Gardens reports (Andrew Sinclair: pers. comm. to Roger Downie) that specimens grown from cuttings taken from the original tree have been planted in beds near the Kirklee gate and that it is planned to develop an interpretation board about Scouler in time for the bicentenary of his first voyage in 2024.

The BLB lecture series

The purpose behind this series – of providing up-to-date accounts of modern natural history delivered by prominent researchers in a manner accessible and interesting to biological science researchers and students, and to GNHS members – has continued. Eleven lectures were listed by Downie *et al.* (2012). The series has now extended to 20, and would have been 22 but for the two empty years of the COVID-19 pandemic. Lecturers and topics are listed in Table 3. Overall, the series remains light on women speakers (20%) and on botanical topics (10%). The lectures continue to be well attended both by GNHS members and University of Glasgow staff and students, and the lecturers appear to enjoy their visit and the challenge of making their science accessible.

CONCLUSIONS

GNHS has now benefitted from the income generated by the BLB Bequest for three decades. With careful

Year	Lecturer	Title
2012	Prof. Dave Goulson	How to conserve bumblebees in the modern world
2013	Prof. James Moore	Making livings: why Darwin and Wallace's theories are worlds apart
2014	Prof. Pete Hollingsworth	Telling species apart with DNA
2015	Prof. Pat Monaghan	Long-term effects of early life conditions
2016	Prof. Mark Wilkinson	Modern natural history of naked snakes
2017	Prof. Gordon Reid	Global conservation of freshwater fishes
2018	Prof. Chris Thomas	Surviving the Anthropocene
2019/20	Dr. Andrea Graham	Natural history of immune defences in this wormy world
2020	COVID-19	
2021	COVID-19	
2022	Prof. Kevin Laland	Evolvability and the function of inheritance

Table 3. The BLB lectures, 2012-2022.

management and some top-up funding, the capital value of the Bequest has kept pace with inflation, as has the income generated, more or less. The activities and projects suggested by Blodwen herself have been put into effect and completed as far as has been practicable. In this paper, we have reviewed the many ways in which the Bequest has enhanced the activities of the Society. It has been encouraging to be able to report innovations, such as the digital developments in *The Glasgow Naturalist* and we expect that the Bequest will continue to support development and innovation in the Society. Grants provided by the Bequest have helped many younger naturalists to develop their knowledge and skills, such as on University of Glasgow expeditions. However, it is a concern that the age profile of regular attenders at Society events tends to be high. For the longer term health of the Society, we need to encourage participation by younger members.

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The molluscs of the Duddingston Loch area, Edinburgh, Scotland: comparison of the present with the 19th and 20th centuries

A.T. Sumner

7 Smileyknowes Court, North Berwick, East Lothian EH39 4RG

E-mail: adriantsumner@btinternet.com

ABSTRACT

The molluscan fauna of Duddingston Loch, Edinburgh, Scotland and surrounding areas has been studied in recent years, and compared with earlier reports, particularly that of D.K. Kevan in 1929–1930. Ten freshwater mollusc species that were recorded in the past have not been found in recent years, while other species have arrived and flourished. Reasons for such changes may include adverse effects of algal blooms and the introduction of certain fish. The terrestrial mollusc fauna in the Duddingston Loch area has not changed in the same way, but several alien species that have become widespread in the Edinburgh area and in Scotland generally have also appeared here. As a result, a total of 76 species of mollusc has been recorded in the Duddingston Loch area, making this one of the richest sites for molluscs in Scotland.

Fig. 1. Duddingston Loch, Edinburgh, Scotland. (Photo: A.T. Sumner)

INTRODUCTION

Duddingston Loch is the largest remaining freshwater body in the city of Edinburgh, Scotland and has attracted the attention of naturalists since the early part of the 19th century, if not earlier. The earliest records of molluscs appear to be those published by Rhind (1836). Since then, occasional records from a number of sources have been published, but the most notable survey was that of D.K. Kevan in 1929 and 1930 with A.R. Waterston (Kevan, 1931). Kevan recorded 44 species of mollusc living in the region of Duddingston Loch, which made it it one of the richest sites for non-marine molluscs in Scotland. Since 1930, several alien species of slugs and snails have entered the country, and there have also been changes in Duddingston Loch and the surrounding areas.

In recent years I have had the opportunity to visit many of the habitats around Duddingston Loch, and have also been able to study literature pertaining to molluscs in the area, and to examine the collections in the National Museums of Scotland. Consequently, a detailed account of the molluscan fauna of the Duddingston Loch area can be provided, and changes in that fauna over the last two centuries or so can be recorded.

Duddingston Loch (Fig. 1) lies immediately to the south-east of Arthur's Seat in Edinburgh (NT2872). The loch and its immediately surrounding area, occupying about 25 ha, was designated a Bird Sanctuary in 1925 (NatureScot, 2023). The loch itself is shallow, with an average depth of 2.2 m (Historic Environment Scotland, undated), and a maximum depth of 3 m (Gazetteer of Scotland, 2022); the bottom of the loch is soft mud (Kevan, 1931). At the western end of the loch is a marshy area, including Wells o' Wearie, which appears to be the main site of inflowing water for the loch. The Duddingston Loch area has since been designated as a Site of Special Scientific Interest (SSSI) (NatureScot, 2023). In addition to the SSSI, the Scottish Wildlife Trust (SWT) has a reserve, Bawsinch, at the south-east corner of the Duddingston Loch SSSI, and since 1971 has managed the SSSI as well as Bawsinch. Bawsinch is an area of trees and scrub, with swampy areas and ponds, leading to the reed beds on the south side of the loch. A wall runs along the south side of the site, separating it from the former Innocent Railway, now a foot- and cycle-path. Since 1963, an area at the north-east corner of the loch has been developed as Dr Neil's Garden, an ornamental garden open to the public, sloping down from Duddingston village to the loch shore (www.drneilsgarden.uk). A sketch map of these areas is provided as Fig. 2.

Duddingston Loch is eutrophic, with extensive reed beds (*Phragmites* sp.). A survey in 2015 found that the SSSI was in an unfavourable condition. Phosphorus levels in the water were high; pH was just on the acid side of neutrality. Algal blooms have occurred in the past, which have probably affected the fauna of the loch adversely; restocking with carp after such a bloom may

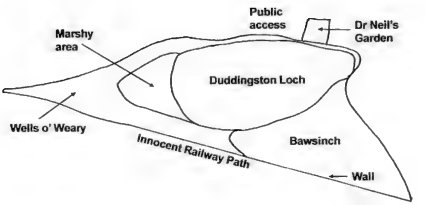

Fig. 2. Sketch map showing the Duddingston Loch SSSI, the SWT Bawsinch reserve, and Dr Neil's Garden. Not to scale.

also have had deleterious effects on other species. At the edges of the loch, woodland has been gradually encroaching on the reedbeds, and attempts have been made to reverse this (NatureScot, 2023; EnviroCentre Ltd., 2015).

METHODS

Land and freshwater molluscs were sampled from the public access at the north side of the loch during 2015 to 2019, from Dr Neil's Garden during a Bioblitz organised by the Royal Society for the Protection of Birds in 2016, and throughout Bawsinch in 2015. Land molluscs were sought by visual searching of vegetation, turning over debris such as stones and pieces of wood, and by examining walls and the vegetation growing on them. Freshwater species were collected from the bank of the loch using a hand net with a 1 mm mesh.

Historical records were extracted from books and periodicals in the National Library of Scotland, and through use of the Biodiversity Heritage Library. Journals examined included *Journal of Conchology, Scottish Naturalist,* etc. Actual specimens from the 19th century up to recent times were examined in the collections of the National Museums of Scotland. Binomial names used are those given by Anderson & Rowson (2020), with names used by earlier authors updated accordingly.

Records are submitted to the Conchological Society of Great Britain and Ireland's database, from which they are copied to the National Biodiversity Network (NBN).

RESULTS

Species recorded by D.K. Kevan (Kevan, 1931) and by the author are listed in Table 1 (freshwater species) and Table 2 (terrestrial species). Many of these species had also been recorded by various authors in the 19th and early 20th centuries (Rhind, 1836; White, 1873–4; Bennie & Scott, 1888–90; Roebuck, 1890; Crapper, 1922; Ritchie, 1923). Table 3 lists species not seen by D.K. Kevan or the present author, but that were recorded by others. Table 4 lists species found at Duddingston Loch which have arrived in the Edinburgh area since Kevan conducted his study in 1929–30.

Species	D.K. Kevan's records[1]	Present author's records	Earliest records
Gastropods			
Acroloxus lacustris	present	1 (B)	Rhind, 1836
Ampullaceana balthica	plentiful		Bennie & Scott, 1888–1890
Anisus leucostoma	present		Rhind, 1836
Anisus vortex		abundant (B,D)	
Bathyomphalus contortus	abundant		Rhind, 1836
Bithynia tentaculata	fairly scarce	abundant (B,D)	
Galba truncatula	present		Roebuck, 1890
Gyraulus crista	fairly common	several (D)	Bennie & Scott, 1888–1890
Gyraulus laevis	present		Roebuck, 1890
Hippeutis complanatus		1 (D)	
Lymnaea stagnalis	sparse	a few (B,D)	Crapper, 1922
Physa fontinalis	sparse	many (D)	Bennie & Scott, 1888–1890
Planorbarius corneus		1 (B)	
Planorbis carinatus		abundant (B,D)	
Radix auricularia	present		Roebuck, 1890
Stagnicola sp.	abundant		Rhind, 1836
Valvata cristata		1 (D)	Rhind, 1836
Valvata piscinalis		empty shells (D)	Rhind, 1836
Bivalves			
Anodonta cygnea		1 (D)	Rhind, 1836
Euglesa casertana	present		Rhind, 1836
Euglesa milium	present		Roebuck, 1890
Euglesa nitida		1 (D)	
Euglesa personata	present		Roebuck, 1890
Euglesa subtruncata		1 (D)	
Sphaerium corneum	not plentiful	1 (D)	Roebuck, 1890

Table 1. Freshwater mollusc species found in the Duddingston Loch area, Edinburgh, Scotland. [1]Kevan (1931). B, Bawsinch; D, Duddingston Loch.

Species	D.K. Kevan's records [1]	Present author's records	Earliest records
Aegopinella nitidula	present	several (B,N)	
Arion ater agg.	not common		
Arion circumscriptus	present		
Arion distinctus	present	few (B,N)	Roebuck, 1890
Arion intermedius	present	few (B)	
Arion rufus		1 (N)	
Arion subfuscus		few (B,N)	
Balea perversa s.s.	present	several (B)	NMS, 1872
Carychium minimum	present		
Cepaea nemoralis	broken shells	several (B)	
Cochlicopa cf. *lubrica*	present	many (B)	
Cornu aspersum	broken shells	many (B,N)	
Deroceras laeve	common	a few (D,N)	
Deroceras reticulatum	present	many (B,N)	Roebuck, 1890
Discus rotundatus	present	few (B,N)	Roebuck, 1890
Euconulus fulvus[2]	present		
Lauria cylindracea	present	a few (D,N)	
Lehmannia marginata	present	a few (B)	
Limax maximus		several (B,N)	
Nesovitrea hammonis	present		
Oxychilus alliarius	present	a few (B,N)	
Oxychilus cellarius	present	several (B,D,N)	
Oxychilus draparnaudi	present	1 (B)	
Oxyloma elegans	present	several (B,D)	
Pyramidula pusilla			Roebuck, 1890;
Succinea putris[3]	present		
Trochulus hispidus	present	1 (B)	
Vallonia cf. *excentrica*	present		
Vertigo antivertigo	present		
Vertigo pygmaea	present		Roebuck, 1890
Vitrea crystallina	present		
Vitrina pellucida	present		
Xeroplexa intersecta	present		
Zonitoides nitidus	present	several (B,D)	

Table 2. Terrestrial mollusc species found in the Duddingston Loch area, Edinburgh, Scotland. [1]Kevan, 1931; [2]subsequently redetermined as *Euconulus alderi* by NMS and confirmed by the author; [3]subsequently redetermined as *Oxyloma elegans* by M.P. Kerney. B, Bawsinch; D, Duddingston Loch; N, Dr Neil's Garden.

Species	Records
Terrestrial gastropods	
Aegopinella pura	NMS, 1930
Pyramidula pusilla	Roebuck, 1890; NMS, 1890
Freshwater gastropods	
Gyraulus albus	Rhind, 1836
Planorbis planorbis	NMS, 1866–1894; Rimmer, 1880
Bivalves	
Anodonta anatina	NMS, 1933
Euglesa lilljeborgii	Kerney, 1968
Euglesa obtusalis	Rhind, 1836
Sphaerium lacustris	Rhind, 1836

Table 3. Species not recorded by D.K. Kevan or the present author. NMS indicates records obtained from specimens in the collections of the National Museums of Scotland (NMS).

Species	First record in Edinburgh[1]	Status at Duddingston
Ambigolimax valentianus	2000	several (D,N)
Arion flagellus	1996	a few (B,D,N)
Arion owenii	2001	many (B,D,N)
Arion vulgaris	2013	a few (B,N)
Boettgerilla pallens	1996	a few (B)
Deroceras invadens	1931	2 (B)
Hygromia cinctella	2012	a few (B)
Limacus maculatus	1981	several (B,N)
Potamopyrgus antipodarum	1956	1 (D)
Trochulus striolatus	1965[2]	many (B,D,N)

Table 4. Species that have arrived in Edinburgh in recent years. [1]Obtained from National Biodiversity Network records; [2]a very few earlier records. B, Bawsinch; D, Duddingston Loch; N, Dr Neil's Garden.

DISCUSSION

Kevan (1931) recorded 44 species of molluscs in the Duddingston "Sanctuary". Further studies, including the author's own, have increased this total to no fewer than 76, not all of which, however, have been recorded as being present at the same time. There are species that were recorded by Kevan which I have not found, and *vice versa*; in addition, there are species recorded by neither of us, but which have been recorded by others. For example, of the 16 freshwater species recorded by Kevan (1931), only six were found by the present author; and 11 freshwater species have been recorded subsequently that were not seen by Kevan. Kevan (1931) also recorded 29 species of terrestrial molluscs, but only 18 of these were found by the present author; another 12 terrestrial species have been recorded that Kevan did not see, in many cases because they were recent immigrants (Table 4). There are several factors that could be responsible for the failure to find certain species. Several species are very small (e.g. *Vertigo* spp. and *Euglesa* spp.) and might be overlooked, although still present. Other species might have been missed because they are uncommon, or have a localised distribution within the area (e.g. *Galba truncatula*). In some cases, particularly with older records, there may be uncertainty about the identification of certain species, because of changing taxonomic knowledge. For example, *Oxyloma elegans* and *Succinea putris* cannot be distinguished reliably on external characters alone, and the characters for identifying them by internal anatomy were not resolved until 1933 (Quick, 1933). Finally, the areas studied by different authors are never defined precisely, but in any case Kevan studied the marshy areas at the west end of the loch, which I was unable to access, while both Bawsinch and Dr Neil's Garden, which I visited, did not exist in their current form in 1930.

Table 1 shows that there are several freshwater species that were common in 1930 but have not been found in recent years, and species that were apparently absent in 1930 but are now common. *Ampullaceana balthica* (formerly *Lymnaea peregra*, a generally common snail) and *Bathyomphalus contortus* were found at various sites at Duddingston in 1929, but have not been found recently. *Stagnicola* sp., formerly abundant, has also not been recorded recently. *Radix auricularia* is another species recorded by Kevan that has not been seen in recent years; in fact, it seems to have been lost from Edinburgh and the surrounding areas, and no live animals have been seen for many years (Kerney, 1999; pers. obs.)

There are two situations in which one species may have replaced another. Kevan (1931) found that *Anisus leucostoma* was common in the marshy areas at the west end of the loch, although it has not been seen since, while *A. vortex*, not recorded by Kevan, is now common. Similarly, *Planorbis planorbis*, though not seen by Kevan, used to be abundant at Duddingston (Rimmer, 1880; Kevan, 1931); now it is the very similar *P. carinatus* that is abundant. It should be noted that the disappearance of *P. planorbis* and the spread of *P. carinatus* is general in the Lothians in recent years (pers. obs.). Another species that seems to have increased at Duddingston in recent years is *Bithynia tentaculata*, fairly scarce in 1929 (Kevan, 1931), but now abundant. The swan mussel, *Anodonta cygnea,* is an interesting case, as Kevan (1931) stated that nothing lived on the soft mud bottom of the loch, although this species was, apparently, known to Rhind (1836). However, even before it was recorded in 2016, otters (*Lutra lutra*) had been seen catching and eating swan mussels (the late Ken Knowles, pers. comm.). In fact, the swan mussel can lie flat on the surface of soft mud and not sink in (Killeen *et al*., 2004), so is well adapted to habitats such as that found in Duddingston Loch. A record of duck mussels, *A. anatina,* seems anomalous, but I have examined specimens in the National Museum of Scotland collections, and the determination appears to be correct. Species that have disappeared from Duddingston Loch might have been adversely affected by algal blooms (EnviroCentre, 2015), or by subsequent introduction of fish, particularly carp (NatureScot, 2023). However, *P. planorbis* seems to have gone well before any such events had been recorded. Species which have increased in recent years, such as *P. carinatus* and *A. vortex,* may simply have been able to exploit niches left vacant by the effects of algal blooms, or could have been introduced when the loch was restocked with fish. Introduction by water birds is another likely mechanism (Kew, 1893).

None of the terrestrial species found in the Duddingston area seems to have shown the dramatic changes undergone by some of the freshwater species. *Cepaea*

nemoralis and *Cornu aspersum* were recorded by Kevan (1931) only as "broken shells", whereas I found them to be common; similarly, the slug *Limax maximus* was not recorded by Kevan, but I found several when I visited the area. However, these species were found particularly in Bawsinch and Dr Neil's Garden, which were not visited by Kevan.

Finally, the ten species should be noted that have arrived in Scotland, and the Edinburgh area, in recent years (Table 4). Many of these species are alien invaders (Kerney, 1999; Rowson *et al.,* 2014), and are now widespread in and around Edinburgh, and it is hardly surprising that they have turned up in the Duddingston area.

In conclusion, there have been many changes in the molluscan fauna of the Duddingston area since the earliest records were made early in the 19th century (Rhind, 1836). This becomes particularly clear when recent records are compared with the comprehensive studies of Kevan (1931); some species present in the past are no longer seen, and others have arrived that were not recorded earlier. This is particularly true of freshwater species in Duddingston Loch itself, which may have been affected by algal blooms and introduced fish. On land, however, the main difference is the arrival of several largely alien species that have become widespread in the Edinburgh area and other parts of Scotland in recent years. No doubt there will be further changes in the future, and it is hoped that continued monitoring of well recorded sites such as Duddingston will help in understanding the reasons for such changes.

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SHORT NOTES

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Recent speckled wood (*Pararge aegeria*) butterfly observations in Lanarkshire (VC77), Scotland

T. Stewart

7 Tay Court, East Kilbride G75 8XA

E-mail: tamstewart2001@blueyonder.co.uk

The speckled wood butterfly (*Pararge aegeria*) is distributed across much of south-west Scotland (Fig. 1) (Butterfly Conservation, 2015). It is found in Argyll and the northwest, across Invernessshire as well as Moray, the Borders and Dumfries and Galloway (Futter *et al.* 2006). The butterfly had previously been long absent from south central Scotland and had not been seen or recorded in the Lanarkshire vice-county (VC77) recording area since the late 19th century. Emmet & Heath (1989) showed that by the early 20th century the population of speckled wood in the U.K. had mostly contracted to western areas such as Wales, south-west England and, in Scotland, parts of Argyll and the Moray coast.

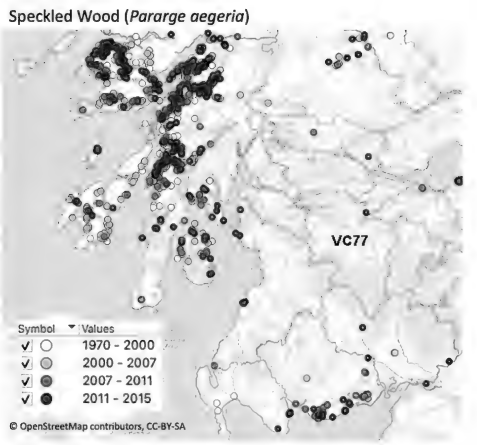

Fig. 1. Speckled wood (*Pararge aegeria*) distribution in South West Scotland (1970-2015). Map compiled by the author using QGIS.

However, since the 1970s the butterfly has been considered to be expanding its range across the U.K. (Taylor-Cox *et al.*, 2020), and it has advanced into Scotland along east and west coastlines from Northumberland and Cumbria, respectively (Futter *et al.,* 2006). Barbour quoted in Sutcliffe (2009) stated that in northern Scotland the butterfly experienced a significant expansion in its geographic range between 1969-1984. Hughes *et al.* (2003) has suggested that evolutionary changes aid in these range expansions, with females at range margins having larger thoraxes indicating a greater dispersal ability.

The earliest record of the butterfly in Lanarkshire is from 1876 at Cadzow, and no records of the butterfly in the county were received throughout the 20th century. With the observed expansion around coastal areas in Scotland, it was only a matter of time before it recolonised the vice-county and the species was first observed again in 2017 with a single record at a site south of Biggar and another at Dolphinton on 19th September. At Damhead farm, Yieldshields on 28th May 2018 another single sighting was recorded, followed by two records in late summer of that year, one in Carluke and another at Carmichael. The following year only one record was received, from Bishopbriggs, when a sighting of a single individual on 30th September was sent to Butterfly Conservation Scotland. During 2020 a record was received of one at Monkcastle Drive in Cambuslang in May, one was sighted at Plains in North Lanarkshire on 20th July and another at Flemington on 2nd August. In 2021 the only Lanarkshire sightings of the butterfly were during autumn with one on 2nd September at Kirklee allotments, Kelvinside, Glasgow, and two were noted on 5th September off Quarry Road in Law.

In 2022 eleven records of the butterfly were received, the first of the year being of an individual found on the U.K. Butterfly Monitoring Scheme transect at Greenhead Moss, Wishaw on the 27th April (Fig. 2). Evidence of breeding in the vice-county came with a single larva of the butterfly found and photographed at Easterbraes, Motherwell on 31st May 2022. RSPB Baron's Haugh gave the next sighting on 15th June. An adult was seen on the transect at Hogganfield Park, Millerston, Glasgow on 25th June and another was noted at Strathclyde Park woodland on 9th July. September brought four single sightings - at Adders Gill, Motherwell on 13th, at Hogganfield Park on 16th, in East Kilbride at K-Woodlands on 20th, and at Crossford on the Clyde walkway on 24th. The final records of 2022 came on the 2nd October at Easterbraes in Motherwell, and the last sighting of the year was on 21st October at Redlees Urban Park in Blantyre.

The 2017-2022 records of speckled wood in the Lanarkshire database of the U.K. Butterfly Monitoring Scheme (UKBMS, 2022) appear to provide evidence of speckled wood spreading into the vice-county from the south and east, and the records from Bishopbriggs and Kelvinside may be showing expansion into VC77 from the north and west (Fig. 3). It will be interesting to observe how this apparent colonisation continues with any further expansion throughout the vice-county in the next few years.

Fig. 2. Speckled wood (*Pararge aegeria*), Greenhead Moss, North Lanarkshire, Scotland, 27th April 2022. (Photo: T. Stewart)

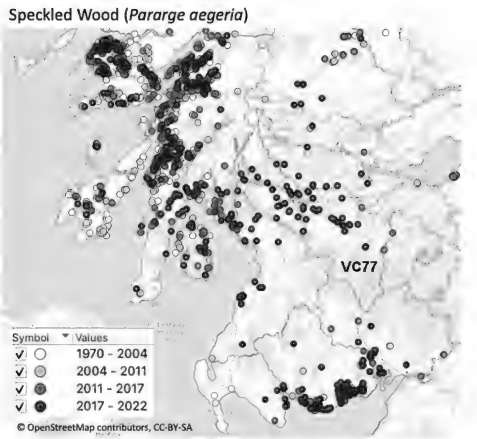

Fig. 3. Speckled wood (*Pararge aegeria*) distribution in South West Scotland (1970-2022). Map compiled by the author using QGIS.

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Water voles as prey for grey herons in an urban environment

E. Reid[1]*, K. Morrison[2], C. Scott[3] & D.J. McCafferty[1]

[1] Scottish Centre for Ecology and the Natural Environment, Institute of Biodiversity, Animal Health and Comparative Medicine, University of Glasgow, Rowardennan, Stirlingshire G63 0AW
[2] NatureScot, Silvan House, 3rd Floor East, 231 Corstorphine Road, Edinburgh EH12 7AT
[3] Neighbourhoods and Sustainability, Glasgow City Council, Exchange House, 231 George Street, Glasgow G1 1RX

* E-mail: elish.reid@glasgow.ac.uk

In 2018 the water vole (*Arvicola amphibius*) population in the U.K. was estimated at 875,000 individuals, with the vast majority identified as riparian, an ecotype that exists along waterways with dense vegetation (McGuire & Morse, 2020). Fossorial water voles, an ecotype that lives a subterranean lifestyle in underground burrow systems and some distance away from water, were first recorded in dry grasslands in North East Glasgow, Scotland in 2008 (Stewart *et al.*, 2017; McInerny, 2021). Water voles have been recorded in 28 out of 64 U.K. cities from 2010-2018, highlighting a more established population of urban water voles than previously thought (Leivesley *et al.*, 2021). Water voles could therefore form an important component of the food web in these urban areas.

On 20th December 2018, Stuart Wilson, a Glasgow-based ornithologist, captured footage of a grey heron (*Ardea cinerea*) holding in its bill a wetland water vole (Fig. 1) at Hogganfield Loch, Glasgow (NS643672) (Wilson, 2018). On the 5th May 2021 at 10:00 GMT, a grey heron was observed by DJM and CS hunting in grassland within Cranhill Park, Glasgow (NS645655). After a failed attempt, the heron succeeded in catching a water vole which was subsequently swallowed alive. The heron continued to search other areas of the park, followed by magpies (*Pica pica*), but no further

predation events were seen. Another observation of a heron capturing a water vole was filmed by KM at Avenue End Road, Glasgow (NS649667) on 12th June 2021 at 09:30 BST. Since then, local residents have also reported to DJM/CS seeing a grey heron hunting water voles within this area of Glasgow. Whilst this predatory behaviour on water voles may be infrequently seen in urban grasslands, heron predation on wetland water voles is well documented. The National Biodiversity Network (NBN) Atlas indicates that in 2019, there were 205 records of grey herons within a 5 km radius of Hogganfield Loch, suggesting a significant population of herons in North East Glasgow (NBN Atlas, 2022).

Fig. 1. Grey heron (*Ardea cinerea*) with water vole (*Arvicola amphibius*) near Hogganfield Loch, Glasgow, Scotland, 20th December 2018. Still from video taken by Stuart Wilson (Wilson, 2018).

Water voles have previously been recorded in the diet of grey herons. In a review of the contents of grey heron pellets in U.K. studies from 1940-1979, water voles occurred in 27-60% of pellets from sites in England and Wales, and in 39% of pellets from Kincardineshire, Scotland (Hewson & Hancox, 1979). Analysis of pellets from a heronry at Lennox Castle, Stirlingshire in 1978 indicated that the water vole was the single most important prey item for herons at this location (Giles, 1981). More recently, it was found that 18% of grey heron pellets analysed from Wales contained water vole fur, more so than any other small mammals (Forman, 2005). This supports findings from across Europe, where it is well recognised that the water vole is a common prey item for grey herons (Feunteun & Marion, 1994; Peris *et al.*, 1995; Jakubas & Mioduszewska, 2005).

Red fox (*Vulpes vulpes*), common kestrel (*Falco tinnunculus*) and common buzzard (*Buteo buteo*) have been seen regularly during the course of water vole surveys (DJM, pers. obs.), and have been observed hunting them (McInerny, 2018); and domestic cats and dogs are known to predate water voles in North East Glasgow (Stewart *et al.*, 2017). Additionally, gulls (*Larus* spp.) and peregrine (*Falco peregrinus*) have been reported taking water voles in Glasgow at both wetland and grassland sites (McInerny, 2018; Shelagh MacMillan, pers. comm.). The predation events reported herein highlight the potential importance of water voles as a prey item for the grey heron and are a healthy sign of a natural food web in this urban environment. However, the commonest predator of the water vole in the U.K. is the introduced American mink (*Neovision vision*), which is responsible for major decreases in water vole populations (Strachan, 2004; McGuire & Morse, 2020). Assessing the risk of mink to water voles and natural food webs in Glasgow is therefore a priority (Wijas *et al.*, 2019).

We thank Stuart Wilson for capturing heron predation on video.

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The non-native scarlet berry truffle *Paurocotylis pila* in King's Park, Glasgow, Scotland

M. O'Reilly[1] & E. Taylor[2]

[1]Scottish Environment Protection Agency, Angus Smith Building, 6 Parklands Avenue, Eurocentral, Holytown, North Lanarkshire ML1 4WQ

[2]3 Arnprior Quadrant, Glasgow G45 9HA

[1]E-mail: myles.oreilly@sepa.org.uk

The scarlet berry truffle (*Paurocotylis pila*), is a non-native fungus that originates from New Zealand. It first appeared in the U.K. near Nottingham, England, in 1973 and is assumed to have been introduced with exotic plants from the antipodes (Dennis, 1975). Since then, it has spread slowly across the U.K., with scattered records in the midlands of England, its first appearance in Scotland being in 1994, and then Northern Ireland in 2010 (Hobart, 2019). In Scotland it has been found around Edinburgh, Inverness, Orkney, and Islay (NBN, 2022) and more recently it has been recorded from Victoria Park, Glasgow (September 2017) and from Spottiswoode, Berwickshire (December 2021) (FRDBI, 2022). According to Pegler *et al.* (1993) it attains a size up to 2.8 cm but Eggerling (2004) found specimens up to 6 cm diameter in Orkney, where it occurred at 53 sites, with usually two or three fruiting bodies, but sometimes 10 to 20, and occasionally up to 40. However, it is still relatively scarce over the U.K. as a whole, with a total of only around 30 records on the Fungal Records Database of Britain and Ireland (FRDBI, 2022).

On 23rd October 2022 four fruiting bodies of scarlet berry truffle were found by ET on the southern boundary of King's Park, Glasgow (NS59636010) on bare soil/mulch under a mature yew tree (*Taxus baccata*) (Fig.1). Two of the truffles were found half-embedded in the soil within a couple of metres of the yew trunk (Fig. 2A,B), and another found loose nearby was broken open and somewhat decayed. The fourth truffle was sitting loose on top of the soil compost about 4 m from the yew tree trunk (Fig. 2C).

Fig.1. The yew tree site for the scarlet berry truffle (*Paurocotylis pila*) in King's Park, Glasgow, Scotland, October 2022. (Photo: M. O'Reilly)

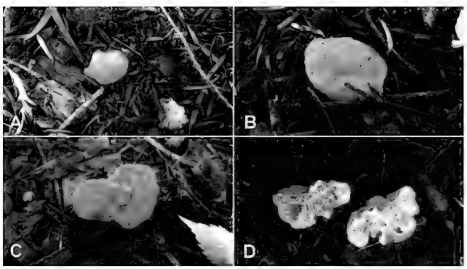

Fig. 2. Specimens of scarlet berry truffle (*Paurocotylis pila*) under yew tree in King's Park, Glasgow, Scotland, October 2022. (A) Embedded in soil mulch; max. diameter 2 cm. (B) Embedded in soil mulch; max. diameter 2.8 cm. (C) Lying loose on soil mulch; max. diameter 3.2 cm. (D) Specimen shown in C, sliced open to reveal internal white gleba inside both halves. (Photos: M. O'Reilly)

The truffles were irregularly ovoid and ranged in size from 2.0 to 3.2 cm (max. diameter). They were a distinct orange colour, rather than scarlet, with the largest specimen being quite wrinkled, presenting the appearance of discarded chewing gum, the latter not unexpected in a busy public park! When sliced open, the inside of the truffles (the gleba) consisted of a white spongy mass (Fig. 2D). The embedded truffles were easily extricated from the soil and it seems that the loose specimens could well have been dislodged by dogs, squirrels, or birds.

In its native New Zealand, the scarlet berry truffle is frequently found under fruiting *Podocarpus* trees and it

is believed that it has evolved to resemble fallen fruit and thus, in the absence of native ground-feeding mammals, to be eaten and spread by ground-feeding birds (Læssøe & Hansen, 2007). It has been speculated that migrating thrush species, such as redwings (*Turdus iliacus*) or blackbirds (*T. merula*), that often feed on fallen berries, may perform a similar role in its dispersal in the U.K. (Hobart, 2005, 2019).

The only previous record in the Glasgow area is of a single small scarlet berry truffle found on a Clyde & Argyll Fungus Group (CAFG) foray in Victoria Park in September 2017. The new find in King's Park, Glasgow, suggests that it may be becoming established in the Glasgow area. Although the fungi of Glasgow's parks have been investigated previously (Marshall, 1979), more recent forays by CAFG have revealed many species new for the area. Notes on some of the interesting fungal finds around Glasgow have been published in this journal (e.g. McInerny, 2019; O'Reilly, 2020, 2022).

The scarlet berry truffle is a distinctive, brightly coloured species and is unlikely to be overlooked. While its presence in the U.K. has been highlighted among mycologists (Barker & Watling, 1993), it is not yet shown in popular U.K. field guides (e.g. Buczacki *et al.*, 2012) and thus may go unrecognised by amateur fungi enthusiasts. It is hoped this note will bring it to the attention of ramblers and perhaps elicit further finds.

Thanks are due to Liz Holden and Roy Watling for help with references for this note.

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Large gulls feeding on fungi in a suburban garden in Glasgow, Scotland

A.P. Payne

The Thomson Building, University of Glasgow, Glasgow G12 8QQ

E-mail: anthony.payne@glasgow.ac.uk

In Britain and elsewhere in the world, lesser black-backed gulls (*Larus fuscus*) and herring gulls (*L. argentatus*) have moved steadily inland from the coast - a move which has necessarily been accompanied by a major change of diet from marine predation to general scavenging (Rock, 2005; Spelt *et al.*, 2019). Much of the scavenged foodstuffs are human-related, so it is noteworthy if these species are found eating unusual but naturally-occurring food, especially where this does not appear to have been previously documented.

In June 2022, I noticed a flock of up to ten lesser black-backed gulls and two herring gulls in a neighbouring garden in Jordanhill, Glasgow, Scotland eating fungi which had appeared on the lawn under a birch tree (*Betula* sp.). The garden is not large (14 x 7 m) and forms a highly enclosed space with a two-storey house on one long side of the rectangle, tall trees opposite, and a garage along one of the short sides; a brick wall about 2 m high forms the fourth side. The gulls visited the garden on three consecutive days (16th-18th June) to eat the fungi (Fig. 1A). They seemed extremely nervous, taking off at the slightest interruption; they were only just capable of clearing the wall. Nevertheless, they kept returning. The mushroom caps were eaten but the stalks

were left (Fig. 1B,C). As new fruiting bodies emerged, I asked permission to retrieve one and this was identified by Dr Alison Moss and members of the Clyde and Argyll Fungus Group as orange grisette (*Amanita crocea*).

Orange grisette is described as having a sweet smell and a sweet, nutty taste (Jordan, 2004; Phillips, 2006), but it is not clear if it is especially attractive to large gull species. Relatively few bird species are known to eat fungi (Simpson, 1998; Elliott *et al.*, 2019). The gulls have not visited the garden on any other occasion.

Fig. 1. Gulls eating fungi, Jordanhill, Glasgow, Scotland, June 2022. (A) Lesser black-backed gull (*Larus fuscus*) eating orange grisette (*Amanita crocea*). (B) Orange grisette with partially eaten cap. (C) Orange grisette stalks after complete consumption of caps. (Photos: A.P. Payne)

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Professor J.H. Connell (1923–2020) at Millport, Isle of Cumbrae, Scotland

P.G. Moore

32 Marine Parade, Millport, Isle of Cumbrae KA28 0EF

E-mail: p.geoff.moore@gmail.com

The following Short Note was prompted by the chance find of two photographs I had taken of the world-renowned ecologist Professor Joe Connell on one of his occasional return visits to Farland Point, Millport, Isle of Cumbrae, Scotland to review the status of littoral barnacles at "his" classic site (Fig. 1). I know of no other photographs of him at this work site. Given his recent passing, I thought it would also be appropriate to remind readers of his local connections and provide some colour to the biographical details in his American obituary (Anonymous, 2020) and Wikipedia entry (Wikipedia, 2023).

Joseph Hurd Connell was American. He graduated from the University of California, Berkeley with an M.A. in Zoology but came to Scotland to study for his Ph,D. under the (relaxed) supervision of Professor C. Maurice Yonge (1899–1986) at the University of Glasgow and the Millport Marine Station, which at that

Fig. 1. Professor Joe Connell studying barnacles at Farland Point, Millport, Isle of Cumbrae, Scotland in 1982 or 1983. (Photos: P.G. Moore)

time was managed by the Scottish Marine Biological Association (S.M.B.A.). His chosen topic was competition between the common littoral barnacles *Chthamalus montagui* (then known as *C. stellatus*) and *Semibalanus* (formerly *Balanus*) *balanoides*. His Ph.D. work resulted in his classic papers on barnacle competition and its mediation by predation (Connell, 1961a,b), which drew praise worldwide and represented landmarks in the field of competition ecology. He went on to equally important prize-winning work on tropical rain forests and coral reefs (Connell, 1978).

His detailed biography and accomplishments have been covered elsewhere (see above), but I wanted to add some local reminiscences of Joe at Millport, where, incidentally, he met his wife. She was Margaret Harvey, an Exeter girl, who was also studying zoology and was the daughter of zoologist Professor Leslie A. Harvey (1903–1986) at the University of Exeter and another devotee of islands, in his case the Isles of Scilly, England.

While engaged upon his researches on Cumbrae and having only limited means, he lived in a tent in the garden of the late Mrs Plant's house - "Ashgrove" - in Marine Parade, Millport, which became known within Marine Station folklore at the time as "the Plantation". I was once told the following anecdote by the late Alex Elliott, the Chief Technician at the Marine Station when it was under the management of the Universities of London and Glasgow. One foggy morning when Joe was crouched on the rocks surveying his barnacles, a MacBrayne's steamer heading for Millport Old Pier loomed slowly out of the murk with a crewman leaning anxiously over the bow peering forward. Seeing Joe on the rocks, he hailed him "Where are we?". Joe, righting himself, yelled back in a broad American drawl "Nantucket!". I once taxed Joe with this piece of Millport folklore but, as he could not remember the incident, it may be apocryphal.

When Joe came back to Millport every few years to re-survey his sites, I had the privilege of assisting him on several occasions, hence my photographs. His pink plastic-rimmed spectacles became his trademark.

I thank Professor Richard Warwick for the dates of Professor Harvey.

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Annual numbers of Atlantic salmon (*Salmo salar*) and anadromous brown sea trout (*S. trutta*) leaping at the Pots of Gartness, Loch Lomond, Scotland

C.J. McInerny

School of Molecular Biosciences, University of Glasgow, Glasgow G12 8QQ

E-mail: chris.mcinerny@glasgow.ac.uk

The Atlantic salmon (*Salmo salar*) and anadromous brown sea trout (*S. trutta*), present in the North Atlantic and many rivers both in Europe and North America that run into this ocean, undergo seasonal migrations moving between rivers and the sea (Sutterby & Greenhalgh, 2005; Freyhof, 2011). Young Scottish salmon hatch as alevins in streams and rivers from where they develop into parr and, as smolts, move out to the Norwegian Sea or North Atlantic west of Greenland to feed and grow before returning to fresh water to mate and spawn; Scottish sea trout perform similar life cycles, although they feed mostly in the coastal marine areas relatively close to the shore. Furthermore, Atlantic salmon are iteroparous, in that adults can return to salt water after spawning, and repeat the breeding cycle in later years, with some fish attaining a significant age and large size.

In Scotland, the Atlantic salmon and sea trout have a long association with humans with, in the past, large numbers present in many rivers, and the fish forming an important component of the Scottish diet (Atlantic Salmon Trust, 2023). However, numbers of both species have dramatically declined in the 20th and 21st centuries, with a range of causes identified and remedial action plans suggested (D.H. Mills *et al.*, 1986; D.H. Mill *et al.*, 2013; Crozier *et al.*, 2018). The Scottish Government has recently acknowledged both the importance of these species and their rapid decline with the development in 2022 of a *Scottish Wild Salmon Strategy* (Scottish Government, 2022), and has published a five-year strategy for the recovery of salmon in an implementation plan (Scottish Government, 2023).

Against this background of general decline a few rivers in Scotland still possess significant salmon and sea trout "runs", one of which is the Endrick Water, which feeds into Loch Lomond, *ca.* 30 km to the north of Glasgow (Adams *et al.,* 2022). About 10 km from where the Endrick Water enters Loch Lomond at Gartness a series of rock strata cross the river which result in waterfalls and pools known as the Pots of Gartness (NS501867) (Fig. 1). To pass these falls salmon and sea trout have to leap the Pots to move upstream to find areas suitable for mating and spawning in the upper reaches of the river (Figs. 2 and 3).

I have monitored the number of Atlantic salmon and sea trout leaping at the Pots of Gartness for six years, from 2014 to 2019, visiting the site on average about once a week through the year and counting the number of fish leaping at the falls; each visit lasted about 10 minutes to 1 hour, depending on water levels. At most times of the year no fish were observed leaping, and although small numbers of fish were seen mid-summer in July and August after rain and the river water levels were higher, the majority of fish were observed to leap from September to November (Fig. 4). At this time of the year autumnal rains resulted in a substantial movement of water through the river encouraging and allowing fish to leap the Pots.

The numbers leaping varied between years, from *ca.* 100 to *ca.* 300 counted, with fish of a range of sizes, from *ca.* 15 cm to *ca.* 100 cm: the smaller most likely "finnock" non-spawning sea trout and the larger being Atlantic salmon. Larger fish were typically more successful leaping the Pots, often passing upstream on their first jump. At the Pots most fish that successfully leapt the falls used the waterfall shown to right in Fig. 1, in which water flowed even with lower water levels; a salmon is shown leaping here in Fig. 2. In contrast, the waterfall shown to the left in Fig. 1 only flowed after more substantive rain, with leaping fish far less successful in passing the falls at this location.

Fig. 1. Pots of Gartness, Endrick Water, Scotland, 8th October 2017. The waterfall to the right flowed throughout the year and was the location where most fish were observed to leap; the waterfall to the left flowed only after more substantial rainfall. (Photo: C.J. McInerny)

Fig. 2. Atlantic salmon (*Salmo salar*), *ca.* 60 cm in length, leaping at the Pots of Gartness, Endrick Water, Scotland, 2nd October 2017. (Photo: C.J. McInerny)

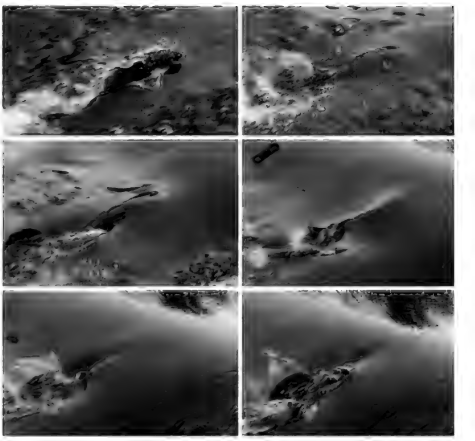

Fig. 3. Atlantic salmon (*Salmo salar*), Pots of Gartness, Endrick Water, Scotland, 26th October 2015. A series of images showing a salmon, *ca.* 50 cm in length, successfully passing the falls (Photos: C.J. McInerny)

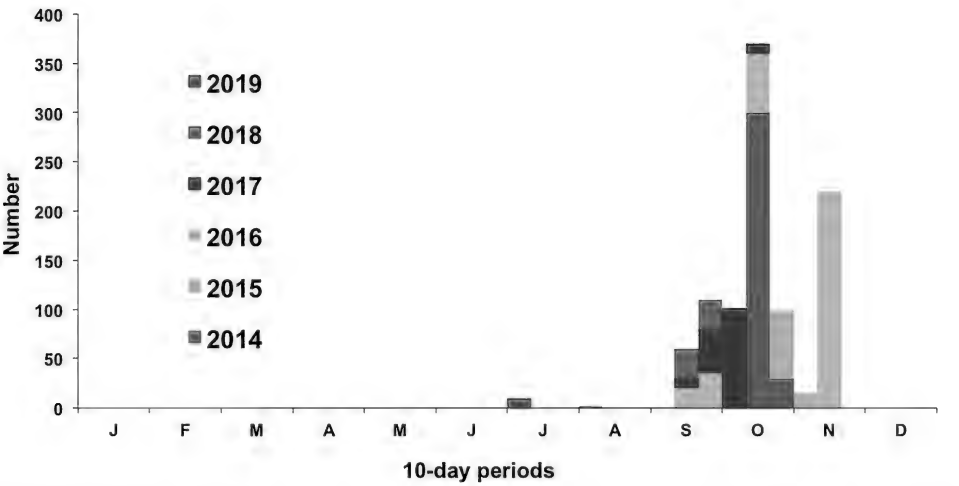

Fig. 4. Annual numbers of Atlantic salmon (*Salmo salar*) and anadromous brown sea trout (*S. trutta*) leaping at the Pots of Gartness, Endrick Water, Scotland, 2011-2019. The site was visited on average once a week throughout the year, when counts were made; where no numbers are plotted, these represent zero counts, which were recorded on most visits.

The predominant autumn leaping of fish at the Pots of Gartness is consistent with fish being present in the upper reaches of rivers in Scotland during the later autumn and early winter months, when they mate and spawn (Atlantic Salmon Trust, 2023). In the future I plan to continue to monitor fish leaping at the falls, counting numbers relative to measured relative water levels, to see if this correlates with the activity of fish. I will also attempt to quantify the successful leaping of fish compared with their size.

I very much appreciate the insightful comments of an anonymous reviewer which substantially improved this Short Note.

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Recent records of the box tree moth *Cydalima perspectalis* (Walker, 1859) (Lepidoptera: Crambidae, Spilomelinae) from the Greater Glasgow area, Scotland

R. Sutcliffe

68 Rowan Drive, Bearsden, Glasgow G61 3HJ

E-mail: sutcliffe_r@yahoo.co.uk

As the name suggests, the box tree moth (or boxworm), *Cydalima perspectalis*, is associated with box, *Buxus* spp. Its distinctive greenish-yellow larvae with longitudinal black stripes eat box leaves and spin a web around the feeding area for protection. In large numbers they can completely defoliate the plant, which can, however, recover in a couple of months, though repeated infestations would no doubt weaken it. The box tree moth is therefore regarded as a pest species (RHS, 2022).

The moth is a native of southeast Asia, occurring in China, Japan and Korea. It was first recorded in Europe in 2007, at sites in Germany and the Netherlands, and has been found in other European countries since then (Straten & Muus, 2010). Its distribution is linked directly to the presence of its host plant.

The first known U.K. occurrence was also in 2007, in Kent, England. It is now well established throughout southern and central England and parts of Wales. There are also some records in Northern Ireland and the Republic of Ireland. The first record for Scotland was from Dalgety Bay in Fife (VC85) on 19th July 2018. Another was found in Fife in 2019 in Dunfermline. It was subsequently also found at Simpson Loan, Edinburgh (VC83) in August 2019. There is also a record from the RHS Box Tree Caterpillar web survey (RHS, 2022) from Gattonside, Melrose, Scottish Borders (VC80) for 11th July 2019 (NBN Atlas, 2019).

In July 2021 there were several sightings in central Scotland, including the Greater Glasgow area, within vice counties 76 and 86. The first of these was noted by Alison Sutcliffe at Oakwood Garden Centre, near Killearn, Stirlingshire on 8th July. It was sitting on the underside of a leaf of a plant for sale there (Fig. 1A). The second example was photographed by Claire MacNab on a window at a plant nursery at Kilsyth, North Lanarkshire on 14th July. One was light-trapped by David Bryant in Bridge of Allan, Stirlingshire on 19th July (all VC86). Kevin Sinclair then trapped one in a 125V MV Robinson light trap on 21st July in his garden in Clarkston, East Renfrewshire (Fig. 1B). Two days later on 23rd July, Gary Williamson also trapped one in a garden moth trap in Simshill, Glasgow. On the same

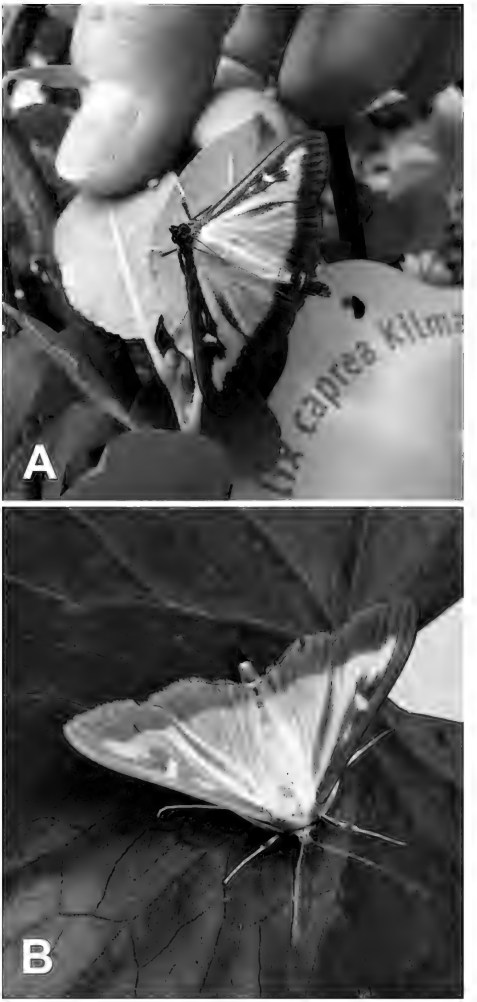

Fig. 1. Box tree moth (*Cydalima perspectalis*). (A) Oakwood Garden Centre, Killearn, Stirlingshire, Scotland. (B) Clarkston, East Renfrewshire, Scotland. (Photos: Alison Sutcliffe (A) and Kevin Sinclair (B))

date, Myles O'Reilly caught one with his trap in Giffnock. All three were recorded from within quite a small area on the south side of Glasgow and all were in VC76.

Two of these records are from horticultural establishments, suggesting that this is likely to be the origin of this pest species. It is probable that the moth could become established in parts of Scotland and any other Scottish records would be welcomed by the author.

Thanks to Mark Cubitt, Martin Culshaw, Myles O'Reilly, Kevin Sinclair, Paul Tatner, Richard Weddle, Gary Williamson, Alison Sutcliffe and Dr Mark Young for information about the individual records.

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Cryptachaea blattea (Arachnida: Araneae): a second confirmed record for Scotland and first for Glasgow

C. McEwan

Flat 3/1, 20 St Andrew's Square, Glasgow G1 5PQ

E-mail: cmcewan74@btinternet.com

On 30th June 2022, I visited the Glasgow Necropolis to search for arachnids and other invertebrates. I was using the grubbing method to search an untended area of long grass and plants, right down to roots level. Whilst searching, a small, female spider appeared in my sampling tray, which I thought was an unusually patterned *Theridion* species. I shared photographs of the spider with my peers on social media. It was from the Theridiidae family, but the images were not sharp enough for an exact identification.

I returned to Glasgow Necropolis daily for the next two weeks and finally found another specimen, again female, on 12th July 2022. The spider was collected using a barrel pooter and transferred to a sample tray. High-resolution images were taken using macro-photography, and these were reviewed by Dr Geoff Oxford, Honorary Secretary of the British Arachnological Society, who confirmed the spider was *Cryptachaea blattea.* From the photographs it was possible to see the diagnostic tubercle (Fig. 1A) on the abdomen (Bee *et al.,* 2020), and the six white guanine spots (Fig. 1B) on the underside of the abdomen, which are characteristic of this species (Oxford, 2021).

C. blattea (Urquhart, 1886) is usually found in trees and bushes, but also favours plastic garden furniture and compost bins. A common Australasian species, it is thought to have arrived in Britain via house plants

imported from Europe (Bee *et al.,* 2020). The species was first recorded in Britain in 2015 but has since been found in a rapidly growing number of locations in southern England and Wales, and scattered sites in the north of England and Scotland. Due to the small number of confirmed records, the spider is currently regarded as extremely rare in the U.K. (Bee *et al.,* 2020). There has been only one other confirmed record of this spider in Scotland (SRS, 2022) at a site in Tarbrax (South Lanarkshire, VC77) in 2019. There were no records for Scotland listed in the NBN Atlas. This find is the second for the vice-county, and confirms the presence of the species in Glasgow, suggesting it could be found at other sites within the city and wider area.

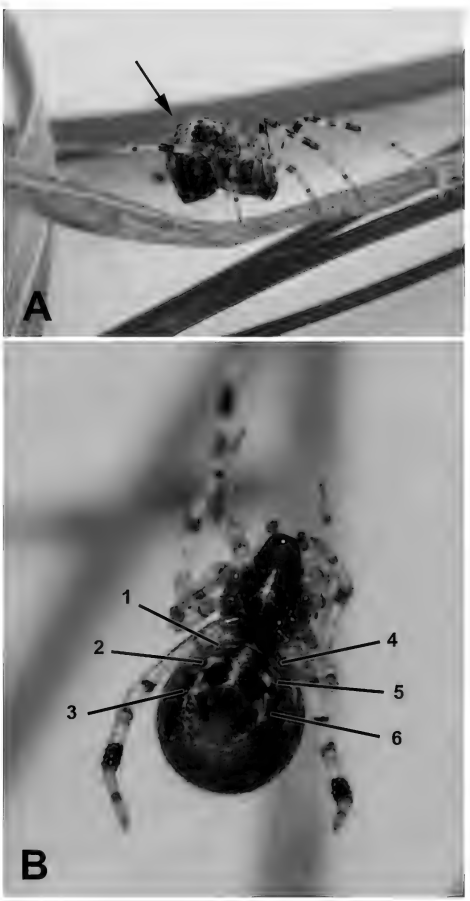

Fig. 1. *Cryptachaea blattea*, female, Glasgow, Scotland, 12th July 2022; length 4 mm. (A) Lateral view, showing diagnostic tubercle on the abdomen (arrow). (B) Ventral view, showing the pattern of six guanine spots (1-6). (Photo: C. McEwan)

My thanks to Dr Geoff Oxford of the British Arachnological Society and Robyn Haggard of the Glasgow Museums Biological Records Centre, Glasgow Life for their time and assistance in identifying the spider and recording the find in the relevant databases.

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Records of the 18-spot ladybird *Myrrha octodecimguttata* (L., 1758) in an Aberdeen garden, Scotland

N.A. Littlewood* & A.G. Knox

SRUC (Scotland's Rural College), Craibstone Estate, Bucksburn, Aberdeen AB21 9YA

*E-mail: nick.littlewood@sruc.ac.uk

On 10th July 2021, AGK noticed a small adult beetle on the windowsill in a room at his home at Cults, Aberdeen, Scotland (VC92). At first glance, he thought it might be a carpet beetle *Anthrenus verbasci*. Closer inspection revealed it to be a ladybird and patterning on the elytra showed it to be a specimen of 18-spot ladybird *Myrrha octodecimguttata* (Fig. 1). This was the first record of the species in VC92 and, indeed, for all of North-East Scotland (administrative regions of Aberdeen City and Aberdeenshire).

Fig. 1. 18-spot ladybird *Myrrha octodecimguttata*, Cults, Aberdeen, Scotland, 10th July 2021. Ruler on right shows mm. (Photo: A.G. Knox)

Just over a year later, on 15th July 2022, AGK found a second individual, this time positioned on a camera trap set in his garden (Fig. 2). This strongly suggested that the initial record was unlikely to be a chance occurrence and that 18-spot ladybird might be established in the area. The species is a conifer specialist, associated especially with Scots pine (*Pinus sylvestris*) (Roy & Brown, 2020). The part of the garden close to where the ladybirds were found contains three mature Scots pine trees, with the tallest reaching about 17 m in height (Fig. 3). Few branches of these trees are within reach of a ground-dwelling ladybird recorder but, on 26th July 2022, NAL and AGK surveyed those that were, by beating them over a washing-up bowl. This resulted in finding a larch ladybird *Aphidecta obliterata* and a third record of 18-spot ladybird (Fig. 4).

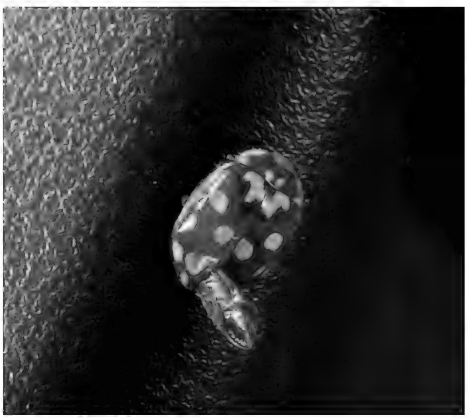

Fig. 2. 18-spot ladybird, Cults, Aberdeen, Scotland, 15th July 2022. (Photo: A.G. Knox)

Roy *et al.* (2011) mapped the then known range of 18-spot ladybird in Britain and Ireland and showed just two hectads in Scotland with post-1989 records, these both being close to Aviemore in Strathspey (Highland). Earlier records were shown in 12 additional hectads in Moray and southern and central Scotland. More recent records (from 2016 onward) posted on iRecord (irecord.org.uk – accessed 30th December 2022) and verified by the U.K. Ladybird Survey show a broadly similar pattern. The majority are in central Scotland, especially Lothian, with others in Strathspey and Moray, and an outlier in Dundee, in 2019.

It seems implausible that 18-spot ladybird is present in North-East Scotland solely in this garden at Cults, Aberdeen. We have not searched crowns of mature pine trees or looked for hibernating adults under bark, both said to be typical haunts of the species (Majerus & Kearns, 1989). However, numerous bouts by the authors of beating low-hanging pine branches elsewhere in the region have produced records of several other ladybird species but no further signs of 18-spot ladybirds. Thus, for now at least, this garden has the distinction of being the only known site for this species in the region.

Fig. 3. Three Scots pine *Pinus sylvestris* trees in the garden, close to, or on which, the three 18-spot ladybirds were found. (Photo: A.G. Knox)

Fig. 4. 18-spot ladybird, Cults, Aberdeen, 26th July 2022. (Photo: N.A. Littlewood)

Many thanks to an anonymous reviewer for constructive comments that helped to shape the final version of this note.

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A mass stranding of buoy barnacles, *Dosima fascicularis*, on the Isles of Coll and Colonsay, Inner Hebrides, Scotland, in July 2020

M. O'Reilly*, A. Morris & J. McKechnie

Scottish Environment Protection Agency, Angus Smith Building, 6 Parklands Avenue, Maxim Business Park, Eurocentral, Holytown, North Lanarkshire ML1 4WQ

*E-mail: myles.oreilly@sepa.org.uk

Goose barnacles of the family Lepadidae are enigmatic creatures that live mostly attached to floating objects drifting in oceanic waters. They can be transported considerable distances by oceanic currents such as the Gulf Stream and North Atlantic Drift, which bring them to British and Irish waters (Trewhella & Hatcher, 2015). They may also occur on ship hulls (Marine Biological Association, 1957; Evans, 2000) but are more usually encountered when cast ashore attached to driftwood or man-made flotsam, especially along the Atlantic facing coastlines of Scotland, Ireland and south-west England. Washed up branches may be festooned with goose barnacles and their coincidental superficial resemblance to geese led to their common name and the myth of the existence of barnacle trees. In times past it was believed that barnacle geese, then unknown to nest in Britain, actually hatched from these goose barnacles as illustrated in medieval bestiaries (Lappo *et al.*, 2019). The specific names of two of the commoner goose barnacle species - *Lepas anserifera* and *L. anatifera* (meaning goose-bearer and duck-bearer respectively) - allude to this mythology.

Occasionally goose barnacles, notably the species of the genus *Conchoderma*, may attach to marine animals including fish, whales, dolphins and turtles. *Conchoderma* spp. are unusual among barnacles in having no, or a very reduced, armament of shell plates (Marine Biological Association, 1957; Berrow *et al.*, 2010; Chan *et al.*, 2021; O'Reilly *et al.*, 2022). One species of pedunculated barnacle, *Pollicipes pollicipes*, belonging to the family Pollicipedidae, attaches to intertidal rock, on exposed coasts battered by waves. It is very rare in the U.K., being confined to a few sites in Cornwall, but is more frequent in Spain and Portugal where it is harvested and sold as "percebes", an expensive seafood (Southward, 2008).

Unlike *Pollicipes* and the many species of pedunculated barnacles from deeper waters, true goose barnacles, i.e. those of the genus *Lepas*, almost all attach on floating objects, which can be either floating free or attached, such as anchored ships and buoys. It is an interesting fact that in tropical seas almost any floating object, even the smallest ones, are almost immediately colonised by *Lepas* species, attaching as the cypris larvae that are common to all barnacles (Chan *et al.* 2021). It was indeed the presence of such larvae, including the naupliar stages that precede the cyprids, that first provided evidence that barnacles are crustaceans. Until then they had been classified as Mollusca together with gastropods, bivalves and cephalopods (Høeg & Møller, 2006).

We emphasise here that the name "goose barnacles", also called "stalked barnacles", does not encompass a natural (monophyletic) unit, but refers to the possession of a long, flexible stalk or peduncle. This is in contrast to "acorn" barnacles (Balanomorpha), which do represent a monophyletic group characterised by, among other traits, the absence of a peduncle (see Chan *et al.*, (2021) for a recent account of the biology and relationships of all barnacles).

While JM was visiting the Isle of Coll, Scotland between 20th July and 2nd August 2020, numerous goose barnacles were observed cast up on all the beaches on the west coast of the island. The beaches, facing the Atlantic, comprised sandy bays with dunes at the back and often rocky stretches on either side. No barnacles were seen at Arinagour beach on the east side of the island.

The biggest accumulation of goose barnacles on the west coast was at Hough Bay, with thousands of clumps of dead and decaying barnacles found on the tide-line, all the way along the beach for hundreds of metres. Many of the barnacles seemed to have been there at least a few days, possibly more, as many of the shells were empty, and very fragile. There was no sign of birds feeding on them and no other animals were observed washed up with them. The weather at the time was sunny and warm enough to swim, albeit with the usual wind on the island. The goose barnacle clumps that were washed into rock-pools were still alive, and some were actively trying to feed. The clumps ranged in size from one or two barnacles up to grapefruit sized clusters. Unfortunately, no photos were taken to help confirm the identity of these goose barnacles. Coll residents had also noticed the cast-up barnacles, and it was reported that the barnacles had been washing up all over the island for at least several days.

Around the same time, AM was visiting the nearby Isle of Colonsay and ventured to Kiloran Bay on 28th July 2020. The weather was sunny with some cloud and a gentle onshore westerly breeze, but there had been some windier weather a few days earlier. On this day many seabirds were noticed scavenging along the tide-line and clumps of goose barnacles were seen in abundance. The bay is approximately 800 m wide, and the goose barnacles were spread across its full width, probably numbering tens of thousands. They were mostly

scattered across the sand at the high-water line, but some were found in a rock-pool at the south-west end of the bay and a clump of these was photographed (Fig. 1). The goose barnacle specimens can readily be identified as the buoy barnacle (*Dosima fascicularis*) due to the thin translucent shell plates, the white cuticle between the plates, and the angular shape of the rear carina plate (Broch, 1959; Southward, 2008). Buoy barnacles have a short stalk, about 2 cm long surmounted by the shelled capitulum which is up to 4 cm in length. They are unusual in that they produce their own float. The larval buoy barnacles initially attach to flotsam but then secrete their own pumice-like buoy to which several barnacles may become attached to form a cluster. The white float is clearly visible in the Colonsay barnacle cluster which has formed on a piece of knotted wrack (*Ascophyllum nodosum*) (Fig. 1).

Fig. 1. Clump of buoy barnacles (*Dosima fascicularis*) attached to their float. Colonsay, Scotland, July 2020. (Photo: Andrew Morris)

Regarding systematics, *D. fascicularis* may need to be transferred to the genus *Lepas.* Recent molecular analyses reveal that it is nested within species of *Lepas.* Thus, from a modern systematic point of view it no longer warrants status as a separate genus, its structural peculiarities notwithstanding (see Chan *et al.*, 2021). Its remarkable flotation device has recently been subject to very detailed study (Zheden *et al.*, 2015).

It seems probable that all the goose barnacles on Coll were also buoy barnacles (*D. fascicularis*). The observations of numerous goose barnacles, stranded on two Inner Hebridean islands, around the same time in July 2020, points to a single extended mass stranding event of a huge swarm of buoy barnacles, driven shorewards from their usual abode out in open waters of the Atlantic Ocean.

Buoy barnacles have been widely recorded on the north-western seaboard of Scotland, with records from Shetland, Fair Isle, Sutherland, the Western Isles, Skye and Rum (NBN, 2022). There are no records currently shown in the NBN Atlas for the islands of Coll and Colonsay although it is quite probable that they are cast ashore here from time to time in small numbers. Mass strandings, as happened in July 2020, are undoubtedly a much less frequent spectacle that bring these enigmatic denizens of the ocean to the attention of holiday-makers and beachcombers. The prevalence of phone cameras and websites and forums (e.g. https://www.aphotomarine.com; https://www.glaucus.org.uk/) aiding the identification of fauna found washed up on our shores should help to gauge the frequency of these unusual occurrences.

Thanks are due to the reviewer, Jens Høeg, who provided very helpful contributions to this note.

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SUPPLEMENT: PROCEEDINGS OF THE GNHS BROWNFIELD BIODIVERSITY CONFERENCE, 4th-5th JUNE, 2022

The Glasgow Natural History Society Brownfield Biodiversity Conference, June 2022: origins, organisation, experience and proceedings

J.R. Downie[1]*, R.B. Weddle[1] & S.N.K. van Mesdag[2]

[1] c/o Glasgow Natural History Society, Graham Kerr Building, University of Glasgow, Glasgow G12 8QQ
[2] School of Geographical and Earth Sciences, University of Glasgow, Glasgow G12 8QQ

*E-mail: roger.downie@glasgow.ac.uk

INTRODUCTION

In May 2021, Scott Shanks (Royal Society for the Protection of Birds) gave a talk to Glasgow Natural History Society (GNHS) on brownfield biodiversity, highlighting some of the sites of interest in and around Glasgow, and posing questions about the importance of such sites for wildlife, in the context of pressures to utilise "unused" land for purposes such as housing. Scott's talk stimulated the idea for a conference and the Society's Council discussed and accepted the broad idea at its September meeting. A subcommittee comprising the authors plus Scott Shanks then set about putting the idea into effect. Unfortunately, pressure of other work prevented Scott from taking part further than the first meeting. Since the COVID-19 pandemic was still a factor, our organising meetings proceeded via the online platform Zoom, with correspondence via e-mail.

We soon agreed that the conference would be a contribution to the 2022 Glasgow Science Festival, thereby essentially fixing the date as Saturday 4th June. Another early decision was that we would offer two excursions to Glasgow brownfield sites on Sunday 5th June, as a follow-up to the conference. We realised that people differed over their responses to the continuing pandemic and therefore that it would be sensible to make the conference a "hybrid", delivered mainly in-person but with on-line attendance an option. We had not attempted this before, but were assured that the University of Glasgow's facilities, available in the Graham Kerr Building's lecture theatre 1, would make it feasible. Having the conference in that building also allowed the use of the Zoology Museum as a poster display venue.

Assembling a set of high quality speakers and topics was the responsibility of Savanna van Mesdag, who is working towards a Ph.D. in the field of anthropogenic biodiversity and geodiversity, and who therefore knows researchers around the country who work in the field. Two of the speakers who agreed to participate were to describe brownfield sites in Glasgow which had been transformed to benefit wildlife: both agreed to lead excursions to their sites on the day following the conference: Martin Faulkner to Hamiltonhill Claypits, and Gemma Jennings to Malls Mire. Through his role at the Glasgow Biological Records Centre, Richard Weddle was in touch with people knowledgeable about many relevant sites, and he took responsibility for encouraging the submission of poster presentations. Roger Downie chaired and minuted the meetings, wrote and submitted a funding application to the Blodwen Lloyd Binns Bequest (BLB) grants committee, and liaised with Glasgow Science Festival, whose EventBrite booking system was used to register members of the public wishing to attend the conference and/or the excursions. The BLB grants committee awarded the conference up to £1,000 to cover speaker expenses, refreshments (so that these could be free to all attendees), speakers' lunches and Glasgow Science Festival registration. As part of the Festival, there was no room hire charge. In the event, costs were a little under £700.

After much correspondence, nine speakers agreed to give talks on the day, one of them (Liam Olds) remotely from south Wales. Most were able to send talk titles and abstracts in advance for the printed conference programme. Eight agreed to present posters, some online (and shown during refreshment intervals) and others physically in the museum. Over 60 people signed up to attend in person, but this decreased to around 40 on the day: the beautiful June weather was perhaps a factor, as well as the Royal Jubilee holiday. We also had about a dozen sign-ups for attendance online, but around six actually turned up. Several members of GNHS kindly volunteered to staff the registration desk and the refreshments stall. Andy Wilson (GNHS photography convenor) generously agreed to take photographs of the event (Fig. 1). Twenty four attendees completed Festival feedback forms, nearly all rating the conference as excellent or very good, with a mean score of 4.4 out of 5. We limited attendance at the excursions to 25 for logistic reasons and, on a beautiful day, around 20 were shown around the Hamiltonhill Claypits in the morning, and a similar number around Malls Mire in the afternoon, some people attending both.

Fig. 1. The conference in session. (Photo: Andy Wilson)

Roger Downie chaired much of the conference, with help from Suzanne Burgess, and provided a brief introduction and summing-up. Suzanne had pointed out that the conference was in some ways a follow-up to the Urban Biodiversity meeting that GNHS had organised in 2010 (Proceedings in *The Glasgow Naturalist* 25, part 4, 2012), and which she had spoken at (as S.Z. Bairner: MacAdam & Bairner, 2012), as had Gemma Jennings (Jennings *et al.*, 2012). As well as providing case-histories of brownfield biodiversity from sites and areas around the country, the current conference included an introduction, by Dominic McCafferty, to a major Natural Environment Research Council-funded project recently underway in Glasgow: "GALLANT- Glasgow as a living laboratory accelerating novel transformation". It will be of considerable interest to watch for the results of this project over the next few years.

In assembling the conference proceedings published here, we found that not all speakers were able to provide written-up versions of their talks. Where this is the case, we provide below only the abstract that was included in the printed conference programme. In one case (Martin Faulkner's paper on Hamiltonhill Claypits), the paper we publish is significantly different from the talk given on the day: the written-up version is a detailed history of the site and the process by which it has been converted into a Local Nature Reserve. To supplement this, Emma Plant has kindly written an account of the site's biodiversity, given in the proceedings but not on the conference day. In another deviation, Gemma Jennings was unable to provide a written-up version of her account of Malls Mire, but this has been produced by her successor at the site, Nicole Digruber. The providers of posters at the conference have been encouraged to develop their presentations into Short Note format papers, and these therefore have become valuable permanent accounts. Roger Downie and Richard Weddle have acted as referees for all these papers and Short Notes, with additional oversight by the Editor. Finally, for completeness, we include brief accounts of the two excursions.

PROGRAMME

Talks

10.00 Roger Downie: Welcome and introduction.

10.15 Savanna van Mesdag: Anthropogenic biodiversity and geodiversity (full version in proceedings).

10.40 Suzanne Burgess: Invertebrates on Falkirk brownfields (full version in proceedings).

11.05 Liam Olds: Invertebrates of colliery spoil.

Abstract

To the north of the Welsh cities of Cardiff, Newport and Swansea lie the South Wales valleys, a landscape of deep river valleys, steep valley sides, and populated valley floors. Here, the landscape and its communities have been shaped by coal mining. The scars of this heavy industry were everywhere to be seen but over time, nature has acted and the valleys are green once again. The black coal tips have been transformed into visually spectacular havens for wildlife, and so too have the former colliery sites. These symbols of a once destructive industry are now, rather ironically, symbols of hope during a time of unprecedented biodiversity loss across the world. Today, these sites support some of the best examples of semi-natural habitat anywhere in South Wales. Given an opportunity, natural processes are both strong and effective. If we make space for nature, it can recover, even in the harshest of environments. In recent years, research by the Colliery Spoil Biodiversity Initiative, National Museum of Wales and Buglife Cymru has highlighted the important invertebrate conservation value of these sites in South Wales. To date, over 1,000 species have been recorded on these sites, over 20% of which are species of "conservation importance" in the U.K. This talk discussed the results of this research thus far, highlighting key habitats and species associated with these sites, and the issues surrounding their conservation.

11.45 Emma Williams: Fungal diversity in coal spoil habitats (no abstract or full version).

12.10 Ellie Kent: The small blue butterfly in south Cumbria.

Abstract

The Back on Our Map Project (BOOM) is supported by the National Lottery Heritage Fund. It is a four-year project led by the University of Cumbria, and is delivered in partnership with Cumbria Wildlife Trust, Natural England, Forestry England and Morecambe Bay Partnership. BOOM is a multispecies restoration project aiming to reinforce and reintroduce a collection of locally threatened or extinct species into the lowland fells of south Cumbria and the coast of Morecambe Bay, reversing biodiversity decline through community action. One such species is the small blue butterfly. There is, currently, a very healthy population of small blue residing on the post-industrial slag heaps of Barrow after a translocation to the site in 2015. The nutrient poor limestone slag provides wonderful growing conditions for their one and only larval food plant, kidney vetch, which is a poor competitor and often gets shaded out in more nutrient rich areas. The slag banks have an unusual topography of steep sided slopes and unpredictable mounds of rock which provide pockets of warm air and

shelter from prevailing coastal winds. These slopes, alongside a wealth of nectar filled plants, such as bird's-foot trefoil and wild strawberry, abundant kidney vetch and tall grasses upon which the butterflies like to roost, provide the perfect habitat for a large population. Therefore, the slag banks have unsurprisingly been selected as a donor population site for our small blue project and as part of BOOM we hope to support the population there through habitat management works, continuous monitoring and kidney vetch planting before conducting a translocation into new sites within the area in the final year of the project. Brownfield sites are incredibly important for the small blue butterfly but in being so put their population at risk through the constant threat of development.

13.35 Liz Parsons: Grassland water voles' colonisation of brownfield sites in the northeast of Glasgow.
Abstract
In 2008, it was discovered that a population of water voles was living in grassland in the East End of Glasgow, a kilometre away from any water. Recent research by the University of Glasgow and surveys by ecological consultancies have found that populations are thriving in very unusual locations including brownfield sites, school playgrounds and in parks. The talk discusses the habitats, survey techniques and the spread of these fossorial water voles and the habitat management taking place in Glasgow to protect and enhance this unusual population.

14.00 Martin Faulkner: 770 metres as the crow flies (full version in proceedings as "Hamiltonhill Claypits Local Nature Reserve- a funder's perspective" followed by Emma Plant's "Biological recording at Hamiltonhill Claypits").

14.25 Gemma Jennings: Malls Mire Local Nature Reserve (full version in proceedings as Nicole Digruber's "Malls Mire Community Woodland").

15.15 Dominic McCafferty: Glasgow as a living laboratory- the GALLANT project.
Abstract
GALLANT is a NERC-funded (£10.2M) five-year partnership between the University of Glasgow and Glasgow City Council and will use Glasgow as a living lab to trial new sustainable solutions throughout the city. While addressing the city's key environmental challenges, this project will consider the co-benefits and trade-offs for public health, wellbeing and economy. The project brings together over 50 multidisciplinary researchers with 29 public and private sector partners across the city region. Together GALLANT aims not only to bring nature back into the city, but make meaningful, lasting change that embeds sustainability across major policy decisions and empowers communities as stewards of their local places. GALLANT will work with local partners and communities to transform the city into a thriving place for people and nature. The project will help Glasgow achieve its goal to be carbon neutral by 2030 and aid climate resilience. The focus of our work involves "Biodiversity and societal benefits of "natural" urban habitats: Nature-based Solutions in an integrated urban-habitats network" and will investigate how cities can play a key role in halting biodiversity loss by restoring and connecting currently isolated habitat patches (see example of green space in North East Glasgow: Fig. 2). We will undertake field studies examining ecosystem services provided by open spaces in the Glasgow region and examine connectivity of these areas for urban wildlife. Local communities and project partners will play a key role in helping researchers to map key species that will inform management practices in open spaces to increase connectivity between habitats.

Fig. 2. Urban biodiversity site near Inishail Road, North East Glasgow, Scotland. (Photo: D. McCafferty)

Posters

Z. Weir & I. McLaren: Havoc Meadows and Brucehill Inland Cliff proposed local nature reserve, Dumbarton, Scotland (full version in proceedings).

J. Birkin: Transforming Scotland's urban landscape into wildlife havens: South Lanarkshire's new local nature reserves (full version in proceedings).

A. Park: Holmhills Wood community park local nature reserve, Cambuslang, Scotland (full version in proceedings).

N. Digruber: Fernbrae Meadows Local Nature reserve: biodiversity on a rewilded golf course in Glasgow, Scotland (full version in proceedings).

E. Plant: Urbanisation had no negative impact on the body condition and size of two bumblebee species (full version in proceedings).

B. Philp: The Garnock Estuary and Ardeer Peninsula: Scotland's first brownfield SSSI? (full version in proceedings).

Excursions

R.B. Weddle & J.R. Downie: Brownfield Conference visits to Hamiltonhill Claypits and Malls Mire (account in proceedings).

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desk and refreshments table; the BLB grants committee for providing funding; Deborah McNeill for Glasgow Science Festival interactions; and Dominic McCafferty for ensuring that the online aspects worked on the day.

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Invertebrates on the brownfields of Falkirk, Scotland

S. Burgess

Buglife, Unit 4, Beta Centre, Stirling University Innovation Park, Stirling FK9 4NF

E-mail: suzanne.burgess@buglife.org.uk

ABSTRACT

In 2009, there were 76 sites registered on the Scottish Vacant and Derelict Land Register (SVDL) in the Falkirk Council area. These sites were assessed in 2010 for Open Mosaic Habitats on Previously Developed Land (OMHPDL) and 19 were identified as supporting this habitat. This contribution outlines the results of surveys for invertebrates conducted at 14 of these sites as well as at two additional brownfield sites not on the register, known locally as Roughcastle and Garibaldi Bing. A total of 266 species of invertebrate was recorded at the 16 sites. Since these surveys were conducted, at least 41 sites listed on the 2009 SVDL have been removed from the register. At least four of these are now recognised by Falkirk Council as sites for wildlife: Carron Works, Mungalend Bing, Bridgeness Road and Bridgeness Scrap. Descriptions of these four sites are provided together with an update on projects and habitat works completed and species recorded.

INTRODUCTION

Derelict land is often known as brownfield land (Macadam & Bairner, 2012). Brownfields are any sites that have been altered by human activity and then abandoned (CABE, 2006). Every brownfield site is different due to its previous historical use, soil conditions and local climate. A history of disturbance and abandonment, alongside a lack of management and poor nutrients in the soil, often allows for the natural process of succession to occur at these sites, creating Open Mosaic Habitat on Previously Developed Land (OMHPDL) (Key, 2000; Bodsworth *et al.*, 2005; Harvey *et al.*, 2008; Burgess, 2022). For a site to be categorised as supporting OMHPDL it must meet five criteria (Table 1) (Riding *et al.,* 2010). It is the lack of management on brownfield lands that makes them ideal for breeding and over-wintering invertebrates, providing a continuity of resources throughout the season (Harvey *et al.*, 2008). An urban setting where there is a network of brownfield lands can create stepping-stones for invertebrates and other wildlife to move and mix across an area and into the surrounding landscape (Macadam, 2011).

This contribution refers to the invertebrates of brownfield sites in the Falkirk Council area, Scotland. The results of invertebrate surveys conducted at these sites in 2010 and 2011 are summarised. Descriptions of four of these sites, which were subsequently recognised by Falkirk Council as sites for wildlife, are then provided together with an update on projects and habitat works completed and species recorded.

SURVEY METHOD AND SITES

In 2009, there were 76 sites registered on the Scottish Vacant and Derelict Land Register (SVDL) in the Falkirk Council area (comprising Falkirk Town and a number of smaller communities including Larbert, Grangemouth, Denny and Polmont). These sites were scattered within villages and towns across the area. The purpose of the study was to identify sites in the Falkirk Council area on the SVDL that supported OMHPDL. An initial assessment was undertaken for each site using Google Maps, to identify the location of each site, any that had been developed, and potential access issues. Eighteen of the 76 sites had an area less than 0.25 ha and therefore could not meet the criteria for supporting OMHPDL (Table 1); 15 of these were visited and included for further habitat assessments as part of the overall study.

Of the 76 sites, seven had recently been developed; there were access issues to four sites that were located within Grangemouth Docks and a further three sites were excluded as they were not easily accessible. This left 62 sites for habitat assessments to be completed on site (including the 15 sites under 0.25 ha in area).

A Brownfield Habitat Assessment Form (Harvey *et al.*, 2008) was completed at each of the 62 sites from May to July 2010, to gather information on current activity, access to the site, the habitats present, plant species diversity and abundance, and any other notes of interest. Photographs were taken on each site for future reference. Potential invertebrate species diversity was estimated as low, medium or high for each site based on plant abundance and plant species diversity on the site as well as the presence of a mosaic of habitats, including bare ground, scrub and mixed grassland and herbs.

From the 62 sites visited, 19 were chosen as being potentially important for invertebrates as these sites fitted the criteria of OMHPDL. The remaining sites on the SVDL were not selected as being important for invertebrates and were not visited again. Twenty-seven of these were not brownfield land but were listed as vacant land. Each village and town visited had sites that were potentially important for invertebrates. However, Banknock, Bo'ness and Larbert all had sites that were particularly important. Of the 19 brownfields fitting the

	Criteria
1.	The area of open mosaic habitat is at least 0.25 ha in size.
2.	Known history of disturbance at the site or evidence that soil has been removed or severely modified by previous use(s) of the site. Extraneous materials/substrates such as industrial spoil may have been added.
3.	The site contains some vegetation. This will comprise early successional communities consisting mainly of stress-tolerant species (e.g. indicative of low nutrient status or drought). Early successional communities are composed of a) annuals or b) mosses/liverworts or c) lichens or d) ruderals or e) inundation species or f) open grassland or g) flower rich grassland or h) heathland.
4.	The site contains unvegetated, loose bare substrate and pools may be present.
5.	The site shows spatial variation, forming a mosaic of one or more of the early successional communities a) – h) above (criterion 3) plus bare substrate, within 0.25 ha.

Table 1. Open mosaic habitat on previously developed land: definition and criteria (Riding *et al*., 2010).

criteria for OMHPDL from the SVDL (Riding *et al*., 2010), 14 were sampled further for invertebrates (Table 2). Of the 14 sites, four were visited four or more times, two sites were visited three times and eight sites were visited twice. This variation was due to limitations of time to complete surveys and to ensure specimens were sorted and identified after collection. Most surveys for invertebrates were carried out from June to October 2010 and then from March to June 2011. Invertebrate records were based on collections made by either sweep nets and/or pitfall traps and on direct observations. Invertebrate survey work was also undertaken at two sites not on the SVDL: Roughcastle (NS845795) and Garibaldi Bing (NS900843). Although these sites are not on the SVDL, they have been previously recognised by Falkirk Council as sites that support OMHPDL.

RESULTS

A total of 266 species of invertebrate was recorded at the 16 sites surveyed (Table 3). This includes 71 species of true bug (Order Hemiptera), 69 species of beetle (Order Coleoptera) and 31 species of spider (Order Araneae) (Table 3). Recorded species of note include: the Red Data Book northern mining bee (*Andrena ruficrus*), recorded from Carron Works and the first record in Falkirk for this species; the Nationally Scarce (U.K. rarity) ground beetle *Amara praetermissa* recorded at Carron Works and only the fourth record for Scotland; the Falkirk Area Biodiversity Action Plan Priority Species common blue butterfly (*Polyommatus icarus*) recorded at Bridgeness Ship Breakers, Carron Works and Roughcastle; and the hobo spider (*Eratigena agrestis*), a brownfield site specialist with few records in Scotland, which was recorded at Bridgeness Ship Breakers during the 2010 and 2011 surveys.

Wildlife site descriptions and updates

Since the 2010 and 2011 surveys were completed, at least 41 of the sites on the 2009 SVDL in Falkirk have been removed from the register. At least four of these are owned by Falkirk Council and are now classified as wildlife sites: Bridgeness Ship Breakers (the two sites listed as Bridgeness Road and Bridgeness Scrap in the 2009 SVDL) in Bo'ness, Carron Works in Stenhousemuir, and Mungalend Bing in Bankside. Falkirk Council designates three kinds of nature conservation sites: wildlife sites, sites of importance for nature conservation and geodiversity sites (Falkirk Council, 2020). None of the other sites removed from the SVDL were identified as supporting OMHPDL through this study.

Buglife have completed projects to manage and enhance habitat for invertebrates at Bridgeness Ship Breakers, Carron Works, Roughcastle and Garibaldi Bing. The following is a description of each of the four sites with information on the projects, habitat works completed and invertebrate species recorded.

Bridgeness Ship Breakers, Bo'ness

SVDL Site Code: F/BNES/032 (Bridgeness Road) and F/BNES/053 (Bridgeness Scrap).

Grid Reference: NT01358164 and NT01428170. Site area: 2.5 ha (combined area).

At least 78 species of invertebrate were recorded in surveys in 2010 and 2011, including the hobo spider. Since then, a further 48 species of invertebrate have been recorded by volunteers during monthly work parties held from November 2015 to December 2018. This work was supported by the Inner Forth Landscape Initiative project Bridgeness Biodiversity funded by Falkirk Environment Trust via the Scottish Landfill Community Fund, National Lottery Heritage Fund, Falkirk Council and the contribution of the LIFE financial instrument of the European Community via the EcoCo Life+ project. During a survey on 1st August 2018, a caterpillar of the alder moth (*Acronicta alni*) was discovered on site. This appears to be the first record in the Falkirk Council area of the species, which is generally uncommon in the east of Scotland.

The site has a mixture of woodland, wildflower meadows, scrub and bare ground. The River Forth is to the north of the site and the route of the John Muir Way passes through it with a footpath well used by residents and visitors to the area. Work parties held through the Bridgeness Biodiversity project cleared scrub from an area of grassland, which opened up this area providing space for wildflowers to bloom. This meadow provides forage for a range of insect pollinators and is particularly important for meadow brown (*Maniola jurtina*), small copper (*Lycaena phlaeas*) and common blue butterflies.

Number of times visited	Number of sites	Site name, location in Falkirk and SVDL code	Sampling methods used
1	5	Bellsdyke Road, Larbert (F/LARB/046); Etna Road, Falkirk (F/FALK/084); Roughcastle, Tamfourhill (F/FALK/091); Stirling Street B, Dunipace (F/DENY/005); Bonnyside Works, Bonnybridge (F/BONY/066)	Mostly general observations as no access to three sites. (Note: The site listed as Roughcastle in this table shares the same name as the site Roughcastle, not on the SVDL and visited for further invertebrate surveys).
2	8	Bankier Road (F/BONY/007) and Distillery Site (F/BONY/008) Banknock; Bathgate Road, Laurieston (F/POLM/057); Cannerton Brickworks, (F/BONY/010; F/BONY/059) and Park Garage (F/BONY/065) in Bonnybridge; Industrial Estate, Tamfourhill (F/FALK/044); West Mains Industrial Estate B, Falkirk (F/GRAN/041)	Sweep net and general observation.
3	2	South Bridge Street (F/GRAN/014) and Ex-Timber Yard (F/GRAN/015) in Grangemouth	Sweep net and general observation.
>4	4	Mungalend Bing, Falkirk (F/FALK/081); Bridgeness Scrap Yard, Bo'ness (F/BNES/032 and F/BNES/053); Carron Works, Stenhousemuir (F/LARB/044)	Sweep net, pitfall traps and general observation.

Table 2. The number of times each of the 19 sites identified from the Falkirk Vacant and Derelict Land register was visited for further invertebrate surveys and the techniques used.

Invertebrate group	Number of species recorded
Arachnida	
Araneae (spiders)	31
Opiliones (harvestmen)	6
Crustacea	
Isopoda (woodlice)	2
Insecta	
Coleoptera (beetles)	69
Dermaptera (earwigs)	1
Diptera (true flies)	25
Ephemeroptera (mayflies)	1
Hemiptera (true bugs)	71
Hymenoptera (bees, wasps, ants and sawflies)	25
Lepidoptera (butterflies and moths)	20
Mecoptera (scorpionflies)	1
Neuroptera (lacewings)	1
Odonata (dragonflies and damselflies)	4
Orthoptera (grasshoppers)	3
Plecoptera (stoneflies)	1
Mollusca	
Gastropoda (snails and slugs)	5

Table 3. Total number of invertebrate species recorded in each group from the 16 sites in the surveys in 2010/2011.

After scrub was removed from the meadow, the diversity of wildflowers significantly increased and included a large number of kidney vetch (*Anthyllis vulneraria*) plants which were not noticed before work commenced. The project also cleared litter and removed non-native species such as sea buckthorn (*Hippophae rhamnoides*) and buddleia (*Buddleja davidii*) from the site.

Carron Works, Stenhousemuir
SVDL Site Code: F/LARB/044. Grid Reference: NS88028251. Site area: 2.53 ha.
At least 135 species of invertebrate were recorded during the initial surveys in 2010 and 2011 with a further 25 species recorded subsequently by the author. The site supports the largest aggregation of sandpit mining bees (*Andrena barbilabris*) known in the Falkirk Council area and also supports populations of the northern mining bee, the klepto-parasitic bee (*Nomada fabriciana*) and the dark-edged bee-fly (*Bombylius major*).

Since the habitat assessment survey at this site in 2010 there has been a significant change to the shape and size of the site (Fig. 1). Part of the south of the site was purchased by Carron Bathrooms to ensure the area could not be developed and a community garden has since been proposed.

The area known for nesting solitary bees was cleared by a local developer in 2015 before they had received planning permission. This significantly reduced the size of the area for the bees but also potentially damaged populations of the ground beetle *A. praetermissa* and hobo spider (the latter recorded at the site in 2014). In 2018, Buglife received funding from NatureScot and a contribution of the LIFE financial instrument of the European Community via the EcoCo Life+ project to create a 20 m long sandy bee bank on site and remove scrub. This increased the area of habitat for the sandpit mining bees and is also well used by a range of other invertebrates for nesting and basking, including ground beetles, ants and spiders.

Grid reference: NS8474479950. Site area: 32 ha.
Roughcastle is a very old large brownfield site. The Antonine Wall (a scheduled monument and World Heritage Site) passes through the woodland. Previous industrial activity that has occurred onsite includes the extraction of minerals in the late 18th century, a fish oil and guano works in the early 19th century, and an old refuse tip in part of the woodland at the north west of the site.

Roughcastle
Surveys in 2010 and 2011 at this site focused on an area of heathland and an open grassland meadow. A total of 155 species of invertebrate has been recorded and includes the narrow-bordered five-spot burnet moth (*Zygaena lonicerae*) and small pearl-bordered fritillary (*Boloria selene*). It is one of two sites in the Falkirk Council area, that the author is aware of, that supports a

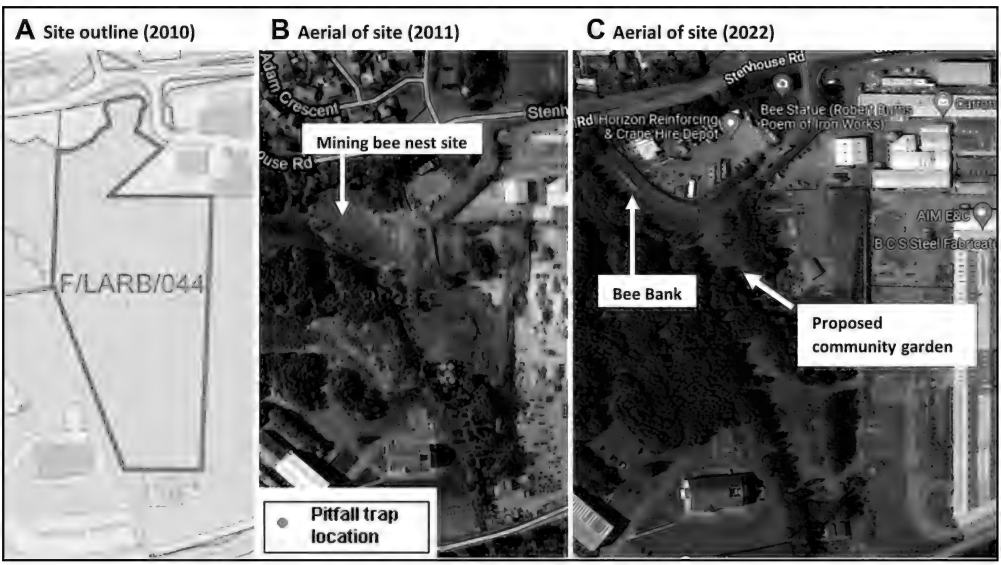

Fig. 1. Carron Works, Stenhousemuir, Scotland. (A) Outline of Carron Works from Falkirk Council's SVDL in 2010. (B) Aerial image of site from 2011 showing location of pitfall traps installed on site and the area of nesting mining bees. (C) Aerial image of site from 2022 highlighting changes on site, reduced area of woodland in south of site, an area proposed for a community garden that has been purchased by Carron Bathrooms, and a bee bank created after the nesting site was destroyed by development. (Aerial imagery © Google Maps)

population of green tiger beetles (*Cicindela campestris*), the other being in the neighbouring section of the Antonine Wall managed by Historic Environment Scotland.

It was noticed during the surveys that woodland was encroaching onto the heathland and areas of the grassland meadow. Projects led by Buglife and supported by Falkirk Environment Trust via the Scottish Landfill Community Fund, NatureScot and the contribution of the LIFE financial instrument of the European Community via the ECoCo Life+ project have run volunteer parties with The Conservation Volunteers (TCV) in 2018 to remove scrub from the heathland and meadow to improve the areas for invertebrates and other wildlife.

Garibaldi Bing

Grid reference: NS9001784314. Site area: 6 ha.

Garibaldi Bing is an old colliery bing (pile of mining waste) located near Carronshore and now forms a raised plateau around the surrounding farmland (Bairner & Macadam, 2011). There is limited access to this site and consequently it receives very few visitors. Around the edges of the bing is mixed broadleaf woodland dominated by silver birch (*Betula pendula*). The surface of the bing is composed of lichens and mosses. There are issues of birch scrub encroaching across the surface of the bing.

During surveys in 2010 and 2011, 104 species of invertebrate were determined. It was identified that the bing was particularly important for ground beetles with large numbers of *Pterostichus madidus, Nebria brevicollis* and *Calathus fuscipes* recorded. The site is also important for common green grasshoppers (*Omocestus viridulus*) and mottled grasshopper (*Myrmeleotettix maculatus*). In 2018, Buglife with volunteers from TCV cleared scrub from an area of the bing that still supported a lichen and moss bed. This was funded by NatureScot and the contribution of the LIFE financial instrument of the European Community via the ECoCo Life+ project.

CONCLUSION

Derelict land in the Falkirk Council area on the SVDL has been identified as supporting OMHPDL and being important for a wide range of invertebrate groups, most importantly true bugs, beetles and spiders. Of the 76 sites on the 2009 SVDL register, 19 were identified as supporting OMHPDL and since then four of these have been removed from the register and are classed as sites for wildlife (Falkirk Council, 2020): Bridgeness Ship Breakers in Bo'ness (the two sites), Mungalend Bing in Falkirk and Carron Works in Stenhousemuir. Buglife have successfully managed projects at four brownfield sites in the Falkirk Council Area to prolong the life of these sites supporting OMHPDL and improve each for invertebrates. Roughcastle, Carron Works and Bridgeness Ship Breakers are visited yearly by Buglife staff to monitor the sites and assess for future conservation works. The location of Garibaldi Bing has caused issues with monitoring this site.

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Holmhills Wood Community Park Local Nature Reserve, Cambuslang, Scotland: biodiversity on the doorstep

A. Park

3 Douglas Drive, Cambuslang G72 8NQ

E-mail: holmhillspark@gmail.com

ABSTRACT

Holmhills Wood Community Park (HWCP) has a remarkable wealth of wildlife considering it lies within the dense Glasgow suburb of Cambuslang, Scotland. It was established in 2001 following the restoration of derelict farmland which had a minor legacy of coal mining. Subsequently a portion of HWCP was lost under the construction of a large education complex but biodiversity has flourished on the remaining part, and most of the area gained Local Nature Reserve status in 2022. Up to now South Lanarkshire Council's maintenance schedule has concentrated on tasks related to public access and safety so that actions to improve biodiversity within key habitats of ponds, woods and grassland have been patchy. Designation as a Local Nature Reserve will bring more emphasis on habitat management and should also promote community engagement with nature conservation on the site. There is a Friends group of community volunteers (FHWCP) ready to help SLC to progress these objectives.

INTRODUCTION

Newly designated a Local Nature Reserve (LNR) in 2022, Holmhills Wood Community Park (HWCP) lies within the town of Cambuslang, South Lanarkshire, Scotland (Fig. 1). South Lanarkshire Council (SLC) owns and manages the site covering 18 ha (South Lanarkshire Council, 2020). Friends of Holmhills Wood Community Park (FHWCP), in partnership with SLC, are active in wildlife recording, biodiversity improvement and community engagement tasks.

RECENT HISTORY

Examination of historical maps shows the site was rural until the 1960s. There was a landscape of enclosed fields with one small wood, presumed to be a plantation, present on the Ordnance Survey First Edition map (1859) (Ordnance Survey, 1859) and named as "Holmhills Wood" on the 1934 (Ordnance Survey, 1934) and later editions. Holmhills Farm operated in the east, Whitlawburn Farm in the west, and possibly West Greenlees Farm also held ground. Only Whitlawburn Farm had buildings that were located within the current LNR boundary (see Fig. 1) and in this vicinity there is evidence of small-scale industrial working for a short period during the 20th Century. Coats Park colliery was

Fig. 1. Holmhills Wood Community Park LNR, Cambuslang, Scotland. LNR boundary marked in red. Map data: Google Earth Image © 2022 Maxar Technologies.

based just north-west of the LNR (Ordnance Survey, 1936) and an aerial photograph from 1946 (Ordnance Survey, 1946) shows new buildings and ground disturbances around the farm site strongly suggesting that coal seams were exploited under the Whitlawburn fields. Remains of farm buildings and mine workings are well hidden within today's woodland, though a single tall standing stone could be left from the farm building, and brick and concrete structures may be related to the mining or its remediation.

By the end of the 1960s, farming was abandoned across Holmhills, Whitlawburn and West Greenlees Farms coincident with Cambuslang's large residential expansion southwards. The new suburb of Whitlawburn directly replaced some farmland and the undeveloped strip sandwiched between Cambuslang and Whitlawburn was purchased by the Local Authority, then Lanarkshire County Council. For the following four decades while the land remained vacant it suffered from fly-tipping and antisocial behaviour, but wildlife colonisation would have surged. The land's status was much improved in 2001 when SLC, with European Union funding, created Holmhills Wood Community Park. This development added woods, ponds, and paths and named the amenity after "Holmhills Wood" the former farm plantation retained in the scheme. Tree cover also endured elsewhere, as did hedges that had marked former field boundaries, and these now enhance current landscape and biodiversity.

Regrettably, some recently planted woodland was lost when three schools (Cathkin High, Rutherglen High and Cathkin Community Nursery) were relocated to a large new complex completed in 2008. Historical imagery and measurement tools from Google Earth (2022) show this development destroyed around 2.5 ha of woodland . Around half of this loss can be attributed directly to construction of the buildings and surrounding hard landscaping, but a similar area of woodland was cleared to provide sufficient sports fields and improved pedestrian access. Conceivably, if the schools had not been built in HWCP, the LNR could have been 20.5 ha in area, instead of the current 18 ha.

However, looking longer-term there could be a benefit for wildlife conservation in having schools next door. Learning outdoors has recently become an integral element of the Scottish Curriculum for Excellence (Learning and Teaching Scotland, 2010) and HWCP offers readily available and high-quality outdoor classroom spaces. It is hoped that pupils' positive experiences of lessons and extra-curricular activities, such as John Muir and Duke of Edinburgh Award Schemes, will give them a sense of the heritage value of the site and encourage a more caring attitude. Additionally, FHWCP are optimistic that some pupils may be inspired to take a special interest in natural history, and thereafter make contributions to wildlife recording and conservation projects.

FHWCP formed in 2012 as a sub-group of Cambuslang Community Council. The group members have a strong interest in nature conservation and were delighted to learn that SLC proposed to designate most of HWCP as LNR. Now that the designation has been completed, we look forward to improved habitat management and assisting with future objectives to protect natural heritage and develop educational opportunities.

HABITATS

There is a range of habitats present within HWCP (Fig. 2). Three small ponds that together constitute only 1% of the LNR's area are wildlife hotspots. The most extensive habitat type is grassland, but two thirds of this is intensively managed amenity grassland with minimal biodiversity. Varied areas of semi-natural grassland, woodland, scrub, tall herb vegetation and overgrown hedgerow complete the habitat mosaic and hold significant wildlife interest when considered within a local context.

Three ponds were created *ca.* 2000, but one has since become seasonal. All have good water quality and various plants that support thriving populations of invertebrates and four amphibian species: common frog *Rana temporaria*, common toad (*Bufo bufo*), palmate newt (*Lissotriton helveticus*) and smooth newt (*L. vulgaris*). In 2016, as part of Froglife's Living Waters project, all the ponds were mechanically dredged to restore open water. It was hoped this would control the extent of New Zealand pygmyweed (*Crassula helmsii*), (Fig. 3) but now this non-native invasive plant comprises over 75% of vegetation of the seasonal pond and dominates further areas of the other ponds. It now seems evident that, post-dredging, the seasonal pond with an expanse of bare earth that stays dry for extended periods favoured recolonisation by pygmyweed rather than native plant species and subsequent transport to other ponds was inevitable. It is possible that dredging, by damaging the compressed clay base of one pond, may have exacerbated the potential for seasonal drying though there have been several dry summers since 2016.

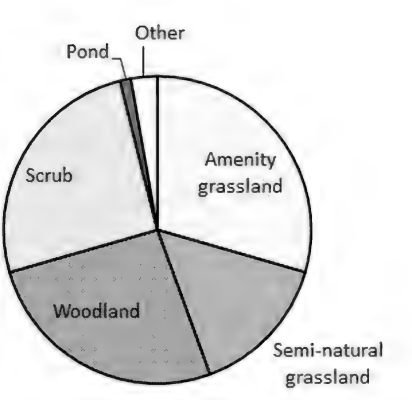

Fig. 2. Habitat composition data from South Lanarkshire Council (2020) based on Phase 1 Habitat Survey completed in 2015 by A. Park.

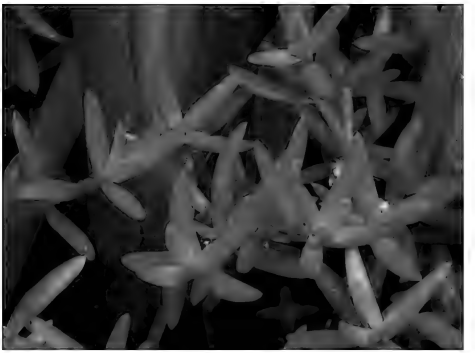

Fig. 3. New Zealand pygmyweed (*Crassula helmsii*) amongst marginal vegetation of a pond in HWCP, 30th May 2022. (Photo: A. Park)

Close to 100 herbaceous plant species have been recorded within the small grassland area near the ponds. Variations in soil dampness support different plant communities with common knapweed *Centaurea nigra*, lady's bedstraw (*Galium verum*), yellow rattle (*Rhinanthus minor*), crested dog's-tail *Cynosurus cristatus* and sweet vernal-grass (*Anthoxanthum odoratum*) in drier areas, and meadowsweet (*Filpendula ulmaria*), cuckoo flower (*Cardamine pratensis*) and rushes *Juncus* spp., in marshy areas. Away from the ponds there are further patches of species-rich grassland, but the remaining unmanaged grassland is much less biodiverse with a large content of coarse grasses and few forb (non-grass herbaceous plant) species. Scattered throughout the uncut grasslands there are some plant species that are atypical for the locality - including cowslip (*Primula veris*), grass vetchling (*Lathyrus nissiola*) and wild carrot (Daucus carota – and it is presumed they survive from recent wildflower planting. Given that there has been no grazing or grass-cutting for over 50 years the presence of such biodiversity is somewhat surprising, but scrub encroachment is now having a negative effect in places. It is hoped that the forthcoming LNR Management Plan will establish annual grass-cutting and scrub control to conserve biodiversity of the best areas and bring improvements to grassland that had become rank due to long-term neglect. Conversely, reduced mowing of the amenity grassland dominating the centre of the site has huge potential benefit for biodiversity, but it is uncertain whether local people would support such a landscape change.

The older "Holmhills Wood", along with four 20-year-old plantations, have a large component of native tree species together with a wide variety of other broadleaved and conifer trees. However, all of these woods distinctly lack the structural diversity of an ancient wood. Holmhills Wood has some fine mature trees, but it seems that the sustained and high level of antisocial behaviour (fire-lighting, trampling, fly-tipping etc.) is seriously checking the survival of understorey, shrub and ground flora layers and the natural decomposition of any standing or fallen dead wood. Bramble patches in this wood, and in parts of the recent woods, form the principal component of the shrub layer presumably because the thorns give some protection against vandals. In most of the recent woodland, except where older trees have been retained, the trees are too closely spaced to promote structural diversity in the near future, but future LNR management should address this shortfall. It is hoped that, before long, the increased emphasis on outdoor learning in schools will help towards bringing about a reduction in vandalism. Forest School sessions occasionally held in the woods, run by community groups for children and young people, should also be effective.

Most times the woods, together with varied areas of scrub, are peaceful and interesting places for naturalists to explore. FHWCP have identified 58 tree species and several woodland ground cover plants including sweet woodruff (*Galium odoratum*), herb-Robert (*Geranium robertianum*), primrose (*Primula vulgaris*) and hedge woundwort *Stachys sylvatica*. In 2019 it was exciting to find the rare yellow bird's-nest, (*Hypopitys monotropa*) (Fig. 4) in one of the young woods. We found 34 spikes of this cream-coloured parasitic plant growing on the ground beside pine and willow trees. After verification by Michael Philip, Lanarkshire Recorder for Botanical Society of Britain and Ireland (BSBI), the sighting was entered onto the BSBI Online Atlas (BSBI, 2022) and subsequently its location marker joined just 21 other records within Scotland. Since 2019 the number of flowering stalks has dwindled, and none were found in 2022. Perhaps underground parts survive and may produce flowers in future years. As a parasite of trees using mycorrhizal fungi to extract nutrients, it may have been brought to the site along with the tree saplings planted *ca.* 2000. Its longevity will require the presence of both the specific mycorrhizal fungus and the tree host.

Fig. 4. Yellow bird's-nest (*Hypopitys monotropa*) in woodland within HWCP, 13th July 2019. (Photo: A. Wilson)

A majority of the bird species listed for HWCP (35 out of a total of 52) are dependent on woodland or scrub for food and shelter. To date, small mammal population surveys have not been attempted, but wood mouse (*Apodemus sylvaticus*) and bank vole (*Myodes glareolus*) have been seen. Amongst larger mammals, the grey squirrel (*Scurius carolinensis*) is abundant and red fox (*Vulpes vulpes*) is a permanent resident. Roe deer (*Capreolus capreolus*) are seen quite often, individually or in small groups of up to six. Since sightings of deer are intermittent with gaps of weeks or months, it is

thought they may roam across a range of local green spaces including Cambuslang Park, Kirkhill Golf Course, Fernbrae Meadows LNR or use green corridors alongside railway lines and the Borgie Glen and Whitlawburn water courses.

CITIZEN SCIENCE AND COMMUNITY ENGAGEMENT

Prior to LNR designation, FHWCP volunteers completed baseline surveys and their unpublished reports, Preliminary Tree Survey (2015) and Phase 1 Habitat Survey (2015), provided useful input during the process of LNR designation.

FHWCP have begun to compile a species list for the site. To date they have identified 278 vascular plants, 52 birds, four amphibians, 12 butterflies and nine dragonflies and damselflies. From 2019, where possible, weekly butterfly transect surveys have been completed following UK Butterfly Monitoring Scheme (2022) methodology. Analysis of butterfly survey data (Fig. 5) shows variations over the 3 years with a marked peak in numbers during 2019 due to high counts for the painted lady (*Vanessa cardui*). U.K.-wide, this long-distance migrant was present in unusually high numbers in 2019 such that Butterfly Conservation declared it a "Painted Lady Year" (Butterfly Conservation, 2019). More tentatively, due to less confident identification skills, FHWCP have recorded bumblebee species along the same transect route since 2018 and have submitted counts to Bumblebee Conservation Trust's BeeWalk monitoring scheme (Comont *et al.*, 2021). We are keen to build our knowledge of pond wildlife and a current focus is to search for larvae and exuviae of Odonata to determine which of the nine species seen as adults (Fig. 6) are successfully breeding in the LNR.

Alongside wildlife recording FHWCP, with SLC, Froglife (Fig. 7) and others, provide community engagement events including pond dips, bat walks, amphibian hunts, wildflower walks, litter picks, scrub clearance, and a dawn chorus experience. Social Media posting https://www.facebook.com/holmhillspark/ is maintained to publicise events and to promote the Park and the Friends group.

FUTURE HOPES AND PLANS

With the LNR designation now in place an LNR management plan will follow, setting out targeted actions to achieve biodiversity improvements together with enhancement of educational and wellbeing opportunities for the local community. The designation and management plan should afford HCWP greater protection and additionally open up new funding streams, such as Nature Restoration Fund administered by NatureScot to extend specific outcomes. FHWCP will continue to monitor wildlife towards helping SLC to review the effectiveness of habitat management work whilst seeking to generate increased support for the LNR amongst the local community. The opportunity to promote HWCP in this publication is appreciated and we hope it may help to generate interest from naturalists further afield.

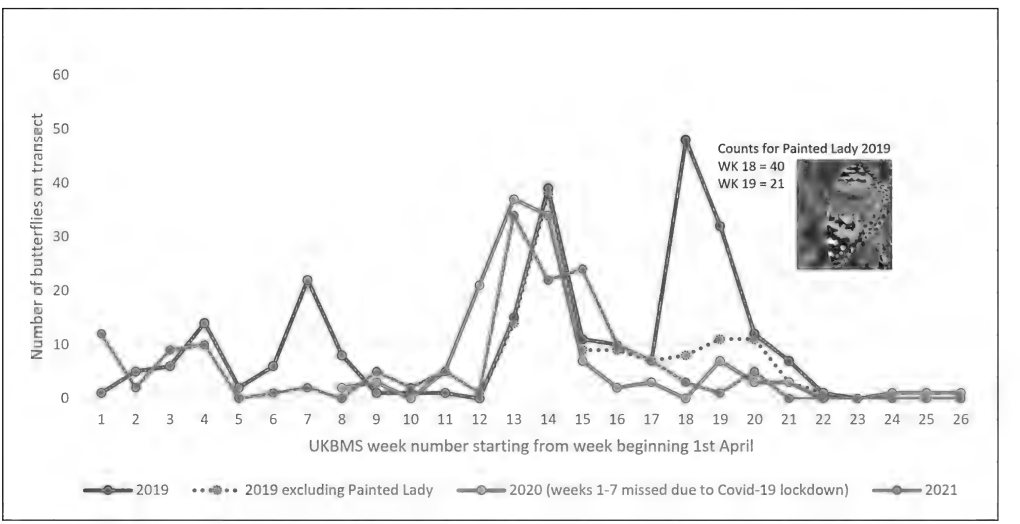

Fig. 5. Weekly butterfly counts 2019-2021 based on FHWCP butterfly transect surveys. Includes U.K. Butterfly Monitoring Scheme (UKBMS) data © copyright and database right Butterfly Conservation, the Centre for Ecology & Hydrology, British Trust for Ornithology, and the Joint Nature Conservation Committee, 2019, 2020, 2021.

Fig. 6. Four-spotted chaser (*Libellula quadrimaculata*).on a dead stem of greater reedmace *Typha latifolia* at HWCP, 28th May 2018. (Photo: A. Park)

Fig. 7. Amphibian survey evening with Froglife at HWCP, 19th April 2018. (Photo: A. Wilson)

CONCLUSION

In summary, HWCP came about because the area evaded development whilst 1960s urban expansion proceeded apace throughout Cambuslang, and thereafter changes in land use have improved biodiversity to a level appropriate for LNR designation. Poor drainage, evident throughout the site, is a key factor in this progression. The risk of flooding, together with the legacy of mining, probably blocked plans for housebuilding, though evidently both issues were dealt with during the schools' construction in 2006. Looking back to the agricultural phase, the wet ground conditions imply that traditional pasture management would have prevailed, and this would have yielded a rich seed source of wildflowers after the cessation of farming. Although for the past fifty years there has been no regular meadow management practised throughout the site there are some areas of species-rich grassland. The biodiverse grasslands are mostly around the ponds with further small patches elsewhere, presumably coinciding with soils that are waterlogged and low in fertility. By contrast, remaining areas of unmanaged grassland comprise a much more limited range of plant species, showing the expected consequence of lapsed management.

At the time when the EU funded Community Park was created, in late 20th century, it had become normal practice to integrate biodiversity when developing public green spaces. Thus, biodiverse elements from the agricultural phase, such as "Holmhills Wood" and defunct hedgerows, were preserved. Additionally, variously aged trees and shrubs were carefully retained within both open land and new woods, and all woodland planting schemes favoured native trees species. Poor land drainage offered good potential for pond creation and three ponds were dug. Following planting with a range of native wetland plants these ponds quickly became valuable new habitats. There were other wildflower planting projects in wetland and grassland plots, notably soon after HWCP opened, but to a large extent the distribution of flora appears to be largely semi-natural. Inevitably, some non-native invasive plant species have colonised several parts of the site.

In the years since HWCP's creation, most of the land, aside from amenity grassland and path verges, has been minimally managed by SLC. In 2016 all ponds were dredged to reverse the natural spread of vegetation and since then, perhaps due to holing caused by excavating machinery, one has become dry for substantial periods of the year. The recent LNR designation raises prospects that all the habitats will receive management sympathetic to nature conservation. SLC are already exploring funding to revisit vegetation removal from the ponds, and a detailed woodland management plan is in preparation. In the future FHWCP hope that an annual programme of partial pond clearance may be instated instead of repeating the more drastic cycle of years of neglect followed by clearing of the whole pond. There should also be consideration given to restoring watertightness of the seasonal pond which currently harbours a large reserve of invasive New Zealand pygmyweed. A desired consequence of woodland management would be an increased structural diversity as this will help to support a greater variety of woodland flora and fauna. Regarding meadow management, it is encouraging to see that SLC have recently introduced this practice at nearby Fernbrae Meadows LNR and should therefore be ready to schedule this also at HWCP. While it is clear that prolonged continuation of extensive areas of amenity grassland areas does not fit with LNR management objectives it is understood that there may be some delay, or design compromise, in order to deal with a pre-existing designation as sports field.

FHWCP have already made an important contribution to substantiating the wildlife value of HWCP and are ready to help with monitoring benefits of LNR habitat management. The group also has an important role to play in the vital LNR aim of helping people to understand and become more aware of the importance of the site. We are optimistic that increased community engagement will lead to a greater acceptance of those

changes in land management that are required to enhance biodiversity, such as reduced grass mowing, and also achieve reductions in damage caused by antisocial behaviour.

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Transforming Scotland's urban landscape into wildlife havens: new Local Nature Reserves in South Lanarkshire, Scotland

J. Birkin

South Lanarkshire Council Countryside and Greenspace Service, Almada Street, Hamilton, South Lanarkshire ML3 0AA

E-mail: Joanna.Birkin@southlanarkshire.gov.uk

ABSTRACT

Four former brownfield sites in South Lanarkshire, Scotland, which have recently been designated as Local Nature Reserves, are described, with reference to their importance for biodiversity, recreation and education.

INTRODUCTION

Across Scotland, Local Nature Reserves (LNRs) are diverse places that include beaches, woodlands, local greenspaces and lochs. South Lanarkshire Council (SLC) wants to give people access to the outdoors in places that are valued for their relative wildness in an urban setting. These places are usable for recreation and education as well as being biodiverse places where wildlife can thrive.

In April 2022 SLC designated a total of 17 LNRs, with 16 new sites adding to the existing one at Langlands Moss (South Lanarkshire Council, 2022). Covering around 600 ha in total, these encompass a broad spectrum of habitats including ancient broadleaved woodland, open water, wetlands, and grasslands. Some sites have already had significant investment to improve their access and other infrastructure, some very little. Similarly, some have excellent community groups who do much work on their sites, while others have none. SLC wishes to continue and expand work on sites, and to keep people interested and involved with their local greenspaces. The Council wants to collaborate with the community to ensure local needs are met and that the public is aware of why these sites are special. Each site has a draft management statement prepared by SLC which gives information on why it is important, and the aims for the site in the future.

Some of the newly designated LNRs are former vacant and derelict land and brownfield sites: Milton near Carluke, Fernbrae Meadows near Cathkin, Redlees Urban Park near Blantyre and Holmhills, near Cambuslang. SLC have also converted a former tip in East Kilbride to create Glen Esk Urban Greenspace. All are now accessible for people and provide improved biodiversity value. Descriptions of these sites, apart from Holmhills, are provided below. Park (2023) provides an account of the urban LNR at Holmhills.

DESCRIPTIONS OF SITES

Milton Tile Works LNR (NS83804976)

This is the site of a former brick and tile works on the outskirts of Carluke. Identified by SLC as vacant and derelict land, it is around 14 ha in size and was inaccessible to the local community. The site supported a mosaic of habitats from bare and previously disturbed ground of the former brick works, semi-improved neutral grassland, marshy grassland, scrub, broadleaved woodland, and open water associated with the former clay pits.

The site is dominated by scrubby willow and birch woodland, which appears to have naturally regenerated following the abandonment of the tile works and tip; rank grassland and tall ruderal vegetation dominate the remaining areas. The woodlands contain some mature trees, with a good ground flora mix and an abundance of deadwood. Spikes of broad-leaved helleborine (*Epipactis helleborine*) can be found throughout the reserve. The site supports three ponds, which are connected by a large, wide drain running north to south. The water in both drain and ponds was stagnant and had very little flow. The ponds were becoming choked by inundation vegetation, which was also holding back the movement of water and causing swamp-like areas to form. Wetter areas give rise to common sedge (*Carex nigra*), common reed (*Phragmites australis*), soft rush (*Juncus effusus*), reedmace (*Typha latifolia*), reed canary grass (*Phalaris arrundinacea*), wild angelica (*Angelica sylvestris*), meadowsweet (*Filipendula ulmaria*) and yellow flag iris (*Iris pseudacorus*). There were some rubble piles and remnants of buildings, along with some areas of fly-tipping.

Access into and across the site was difficult, due to the very wet uneven ground and deep drains running between the ponds. There were several large stands of Japanese knotweed (*Reynoutria japonica*) and snowberry (*Symphoricarpos albus*) on the site.

In 2018 SLC commissioned an environmental survey and monitoring project at Milton with the aims of characterising the ground-gas regime, undertaking shallow soil-sampling and water sampling. Boreholes (Fig. 1), ground-gas, and groundwater monitoring wells were installed for monitoring purposes.

Fig. 1. One of the remaining borehole covers at Milton LNR. (Photo: SLC Countryside & Greenspace Services (CAG))

Fig. 2. Milton LNR. Wildflower and access improvements. (Photo: SLC CAG)

In 2020, significant site works were undertaken at Milton thanks to the Vacant and Derelict Land Fund. Three new access points were created, one of which has parking spaces. Paths and boardwalks were installed along with benches and a central design incorporating reclaimed bricks in a Celtic knot pattern (Fig. 2). Drainage has been improved throughout the site and a dipping platform was installed at the larger pond. Wildflower seeds were sown in many areas to help improve both grassland diversity and pollinator habitats. This new LNR now provides a much-welcomed asset to the local community.

Fernbrae Meadows LNR (NS61925879)

This LNR covers an area of 37.8 ha on the western edge of South Lanarkshire at the boundary with Glasgow. It is situated between the Rutherglen communities of Fernhill and Cathkin, and Castlemilk in Glasgow. Fernbrae Meadows comprises the former Blairbeth Golf Course and part of Cathkin Braes Country Park.

The southern half of the reserve is dominated by broadleaved woodland, which forms part of Cathkin Braes Country Park (CP), and is managed by Glasgow City Council. Cathkin Braes CP covers around 199 ha of land and includes woodland, ancient woodland, heath and grassland. At 200 m above sea level, the park provides views over the city to the Campsie and Kilpatrick Hills on a clear day. There are many paths linking the existing country park to the LNR.

The closure of the golf course in 2015 left a significant area (22.33 ha) of formal amenity grassland which has now been turned into a community greenspace. In 2018 SLC with help from NatureScot's (NS) Green Infrastructure Fund, established a variety of new habitats at the LNR: ponds and associated marshy grassland, an orchard and native woodland planting to link to existing woodland in the south of the site. Native wildflowers have been sown in large swathes of grassland, in which can be found plants of interest including common-spotted orchid (*Dactylorhiza fuchsii*), northern marsh-orchid (*D. purpurella*) and greater butterfly-orchid (*Platanthera chlorantha*).

A new community group linked with Fernbrae Meadows emerged before the redevelopment of the urban greenspace was completed. A group of interested residents first met in April 2018 and became constituted as the Friends of Fernbrae Meadows in January 2019.

The Friends of Fernbrae Meadows organised an official opening event for the site in June 2019. The event was attended by representatives from SLC, NS, local schools, Community Links volunteers and 400 members of the public. An information leaflet about Fernbrae Meadows was created for the opening in a collaborative effort between the Friends and local school children who designed a logo for the group.

The group continue to plan regular community events focusing on community connection, taking care of the surroundings, and developing the space for biodiversity, while also researching the history of the landscape. The Friends engage the wider community through social media and have several volunteers interested in

photography who have provided visual content through photographs and drone video footage. For further information on the group's activities, see Digruber (2023).

Educational establishments have been actively engaged with the space throughout its development by helping to plant trees and wildflowers (Fig. 3). Fernhill School uses the site for Forest Kindergarten, outdoor learning and cross-country running. There are several spaces designed specifically as outdoor classroom areas, but groups visit on a flexible basis accessing the entire site.

Fig. 3. Fernbrae Meadows LNR. (Photo: SLC CAG)

Redlees LNR (NS680598)
This is located to the north of Blantyre: the 27 ha site is bordered from its southern tip to northwest corner by the Glasgow to Hamilton railway line. The Rotten Calder Water runs from the northwest to the northern-most point. The reserve is a part of the larger LNR named Bothwell, Blantyre and Uddingston.

Previously part of the Calderbank House Estate, the site was requisitioned by the Government during World War II, during which time an anti-aircraft battery was installed within the central portion of the site. A clay quarry existed on the site and is understood to have operated until the late 1980s. Since then, various environmental improvement works have been undertaken on the site. Formerly, landscape improvement, bunding, and woodland planting was done. Path works and further woodland planting were conducted in the 1990s and latterly, from 2010 to 2012, a comprehensive project involved the construction of a range of footpaths, installation of interpretation, renovation and stabilising of the World War II structures, and construction of a car park in the northeast. The quarry pond (Fig. 4) was developed as a coarse fishery in the 2000s and is a key feature of the site.

Approximately 16 ha of the 26.7 ha site is covered by woodland. The existing woodland consists almost entirely of broadleaf species, silver birch (*Betula pendula),* oak (*Quercus* spp.*)*, alder (*Alnus glutinosa*),

Fig. 4. Redlees Quarry LNR. (Photo: SLC CAG)

ash (*Fraxinus excelsior*), aspen (*Populus tremula*), wild cherry, (*Prunus avium*), rowan (*Sorbus aucuparia*), hazel (*Corylus avellana*), hawthorn (*Crataegus monogyna*) and willow (*Salix* spp.). A proportion of the woodland of Redlees has been planted in the 1980s and 1990s. Woodland can be found along the banks of the Rotten Calder Water, with some mature sycamore and beech being in the order of two hundred years old.

More recently Scottish Forestry WIAT (Woodlands in and Around Towns) funding included some woodland management works. These focused on the clearing of some of the hawthorn (*Crataegus monogyna*) regeneration within woodland, and the clearance of small areas of woodland to facilitate the creation of footpaths. Woodland management has encouraged natural regeneration and has improved the existing standing woodland. Additional diversity of habitats was provided, as a proportion of the thinning was left on site as deadwood. The hazel woodland has been brought under a coppicing regime to add to the biodiversity of the ground flora and improve the woodland edge to allow for a variety of scrubland birds known to use the area, including yellowhammer (*Emberiza citrinella*) and Eurasian tree sparrow (*Passer montanus*). The funding also aimed to control the invasive Japanese knotweed found on the banks of the Rotten Calder.

Glen Esk Urban Greenspace (NS6556555031)
Located in East Kilbride, this was a former landfill site left to regenerate naturally, subsequently dominated by birch and willow scrub. The site was much neglected, used only by local dog walkers, and as a short cut to the local school. In 2019/20 SLC collaborated with the local community to explore how to spend the £1 million awarded by the Scottish Government Vacant Derelict Land Fund.

The 7.6 ha site now incorporates native planting and habitat creation, footpaths, artwork (Fig. 5), an outdoor classroom, and a car park. Habitats of open water, wet meadow, wildflower meadows, planted trees and marshy grassland were added to increase the biodiversity value of the park.

Fig. 5. Glen Esk Urban Greenspace; artwork and path improvements. (Photo: SLC CAG)

The network of paths now forms an important link between residential estates by improving the quality of paths and greenspace networks. This has been achieved by the addition of boardwalks (Fig. 6) and all access pathways. The greenspace links to areas of broadleaved woodland in the surrounding landscape connecting to an extensive wildlife corridor following the wooded banks of the Rotten Calder Water within Calderglen Country Park.

Fig. 6. Glen Esk Urban Greenspace; boardwalk and pond. (Photo: SLC CAG)

The local community and schools now use this once unloved area. The residents have created the Facebook page Glen Esk "Pocket Park" (https://www.facebook.com/gleneskpocketparkeastkilbride/) and regularly record the wildlife observed at the park. They take pride in their new park and regularly organise events, health walks and encourage the local community to take an interest in the wildlife. Nearby schools visit and have helped sow seeds and plant wildflower bulbs.

CONCLUSIONS

The former brownfield sites described are now being managed for biodiversity, so becoming assets to the local community as well as attracting visitors from further afield. In addition to recreation, with its attendant health and well-being benefits, the sites are used for outdoor education, and several of them have inspired involvement by the local community groups and individuals in maintaining them and recording wildlife.

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Hamiltonhill Claypits Local Nature Reserve, Glasgow, Scotland: a funder's perspective

M. Faulkner

NatureScot, Caspian House, Mariner Court, Clydebank Business Park, Clydebank G81 2NR

E-mail: Martin.Faulkner@nature.scot

ABSTRACT
The Hamiltonhill Claypits Local Nature Reserve is a success story for people in inner city Glasgow experiencing and valuing nature. This paper describes some of the background complexity of the policy and funding, and nature-based benefits arising from the project. It argues that we need to understand how working together will be necessary to replicate this success in the future.

INTRODUCTION

Hamiltonhill Claypits Local Nature Reserve (LNR) is one of 12 LNRs within the boundary of Glasgow City Council, though that will soon be increased to 22 (Millar, 2022). The LNR is only 770 m from Junction 15 of the M8 in central Glasgow (NS674676), providing an opportunity for the quiet of nature to be experienced a remarkably short distance from one of the busiest junctions on one the busiest roads in Scotland.

Hamiltonhill Claypits LNR was designated by Glasgow City Council in May 2016 under Section 21 the National Parks and Access to the Countryside Act (1949). In order to be designated under the Act, an LNR must be at least of local importance for its natural heritage, and its purpose can be for the preservation of nature access and access to nature for education and study. However, policy and the understanding of the contribution of nature to well-being has developed since the 1949 Act, and now LNRs are as valued for the informal enjoyment of nature they provide, and their contribution to sustainable lifestyles (Scottish Natural Heritage, 2000). NatureScot evolved from the Nature Conservancy, through the Nature Conservancy Council and most recently was known as Scottish Natural Heritage. In fact, that is still the legal name under the founding primary legislation. NatureScot is a non-departmental public body of the Scottish Government, with a remit to "improve our natural environment and to inspire everyone to care for it" (NatureScot, 2022) (Figs. 1 and 2).

One of our methods for progressing these aims is as a funder, and we became involved with the Hamiltonhill Claypits both in a statutory role as a consultee for designation, and by funding staff promoting greenspace in Possilpark. NatureScot's current involvement with Hamiltonhill Claypits LNR is broader, and involves far

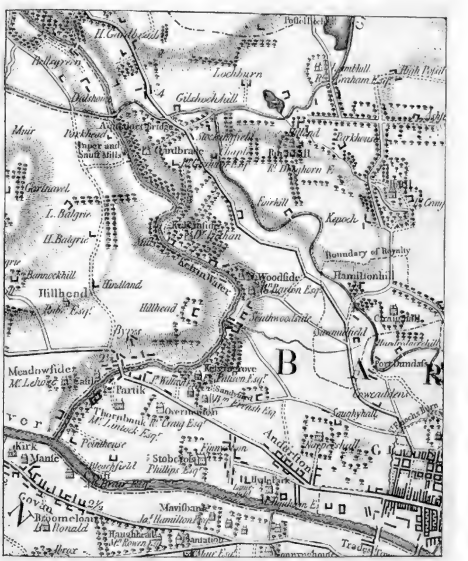

Fig. 1. 1790 map of Hamiltonhill area, Glasgow. (© National Library of Scotland)

larger sums of money sourced from the European Union. NatureScot was successful in applying to the Scottish Government to be the manager of the Green Infrastructure Strategic Intervention (GISI), which is one of the sustainability strands of the 2014-2020 European Regional Development Fund (ERDF) (NatureScot, 2016).

This is a significant departure for NatureScot, as the ERDF is an economic development fund aimed at increasing economic activity and employment in large regions that are not as developed in order to redress imbalances between regions (European Commission, 2014). The value of nature to society and the economy has long been overlooked, but is now increasingly being recognised (Dasgupta, 2021). However, translating that into practice is a challenge, which is why taking on the GISI was never simply about a set of projects, but is a demonstration of how helpful a nature-based approach can be in addressing climate change, biodiversity loss and other linked societal challenges.

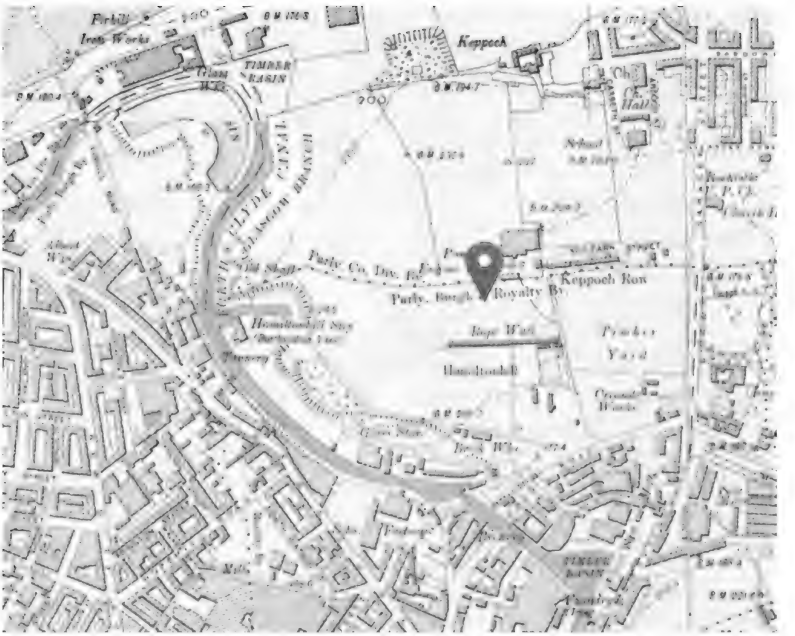

Fig. 2. 1900 OS map of Hamiltonhill area, Glasgow. (© National Library of Scotland)

HAMILTONHILL CLAYPITS LNR AND ITS FUNDING HISTORY

Hamiltonhill history

The Hamiltonhill Claypits is inextricably linked to the canal and the industrial history of Glasgow. The area was at the forefront of the Industrial Revolution, and at that time the canal network was the road and rail network of its time. The Claypits was the source for the clay required to seal the Glasgow branch of the Forth & Clyde Canal. The idea for a canal across Scotland over the shortest stretch of land between the Atlantic and the North Sea was first suggested by Daniel Defoe in 1724 (Scottish Canals, 2017). However, construction did not start until 1768 when John Smeaton surveyed a route, and had advice from the Scottish geologist, James Hutton (Clyde Waterfront Partnership, 2014). Construction was halted just north of Glasgow in 1775 because of lack of funds, but city merchants raised the money for the Glasgow branch in 1777, with formal opening in 1790. Barges brought raw materials and manufactured goods to and from Speirs Wharf near the heart of Glasgow. The completion of the link to the Monkland Canal in 1794 enabled iron and coal to be transported (Scottish Canals, 2017).

By 1900 the canal corridor was heavily industrialised, with iron works, glass works, timber basin, boatbuilding yard, tannery, brick works, factory, brewery and mine shaft all next to the area that is now the LNR. There were several sources of rock containing shale oil in the Possil area, and there were wharfs receiving the rock on the canal. Oil works were also in the Port Dundas area (AVHT, 2022), but it is not clear why the Applecross bing is where it is.

The industrial landscape in Glasgow changed dramatically later in the 20th century and the Claypits became a part of local dereliction. The rights of navigation were removed, and the canal closed in 1962. The situation turned round in 2000 when the canal reopened (Scottish Canals, 2021).

Scottish policy context

To understand how the capital works Green Infrastructure Funds sit within Scottish Government policy it is easier to consider the Outcomes first, because there is the potential to cut across so many areas of policy.

The five Outcomes we are aiming for are summarised in Table 1, but a key aspect of well-planned green infrastructure is that it addresses multiple societal issues simultaneously (International Union for the Conservation of Nature, 2020). Although applicants to the GI Fund could have aimed to meet only one of these Outcomes they would have been very unlikely to have been awarded funding, as each Outcome was assigned 20% of the overall score and there was stiff competition for limited funds. In the second phase of the Fund we had £8 million to award, but £16 million worth of applications.

Scottish Planning Policy (Scottish Government, 2020) and the Scottish Planning Framework 3 (Scottish Government, 2014) are the two documents relevant to infrastructure planning, and from which all strategic and development plans created by Planning Authorities arise. The implementation of all policies should support

Outcome	Explanation
Nature, biodiversity and ecosystems	Improved green infrastructure enhances and restores the biodiversity and ecosystem function of an area, helping our urban ecosystems to be more resilient to change.
Environmental quality, flooding and climate change	Our greenspaces and routes are multifunctional, providing improved ecosystem services for communities, helping us adapt to and mitigate climate change, improving our air and water quality, improving the ecological status of water bodies, managing surface water runoff and reducing flooding.
Involving communities and increasing participation	Enjoying the outdoors has become much more common and is part of our culture. People explore the area to experience nature, relax and stay fit.
Increasing place attractiveness and competitiveness	Places are more attractive to live, work and invest in and more economically competitive as a result of green infrastructure improvements. More people use the greenspace and more people say that the greenspace meets their needs.
Improving health and wellbeing	Greenspace becomes a central feature of people's lives and they recognise and welcome the role it plays in their day to day well-being and happiness. Communities' health and well-being improves through the use of greenspace.

Table 1. Green Infrastructure Strategic Investment Outcomes (NatureScot, 2016).

The work at Claypits is part of a larger project which includes a cutting edge approach to rainwater management in Sighthill and Hamiltonhill costing approximately £15 million in green infrastructure, of which approximately £10 million is for the rainwater management. To achieve the same result using a traditional grey infrastructure solution would cost approximately £50 million, and make the regeneration project financially non-viable (Robinson, 2016).

The ERDF investment between the Claypits, Sighthill and Hamiltonhill is approximately £5.6 million. Port Dundas is also in the current project, but we could not fund that area because of private investment. After Hamiltonhill, the next phase will be at Cowlairs. Unfortunately that is beyond the time limit for the Green Infrastructure Fund. These are all part of Glasgow City Council's mitigation of flood risk and adaptation to climate change.

An important part of this project is the financial stacking and backing. The Green Exercise Partnership put £100,000 into the project creating a barrier free path between the LNR and Garscube Road, so that the Woodside Health Centre could more realistically prescribe visiting and volunteering in the LNR as part of addiction recovery and maintaining well-being. Although this is a relatively small amount of money compared with the other investment it helped make the overall project viable, and demonstrates confidence that the health benefits will be realised.

Highlighting alternative funding models to achieve multiple benefits is essential if we want more investment in greenspace. The scale of the investment required can be seen by considering the Central Scotland Green Network (CSGN), which is one of Europe's largest green infrastructure projects (CSGN, 2011). Hislop & Corbett (2014) estimated that the potential cost of implementing all of the parts of the CSGN alone would be £2.8 billion. Since then, construction costs have increased markedly and several of our projects needed to request an increase in funding, citing the impact of leaving the EU and the after-effects of the COVID pandemic.

There are two common barriers to significant investment mentioned in the literature, i.e. silo thinking and evidence of impact (Aquilina & Sheate, 2022). The Green Exercise Partnership investment above is a good example of achieving their own objectives and others simultaneously. The other common hurdle is lack of an evidence base that green infrastructure can provide a reliable funding stream for investors (Young *et al.*, 2022). Meanwhile, the community-based Management Group has made a great start at introducing more people to the LNR by leading guided walks, organising essential management (like litter picks), and encouraging people to record their sightings on the LNR website (Hamiltonhill Claypits Local Nature Reserve, 2022).

In a tightened public spending landscape there is not enough public money to deliver all the change that is required to make our cities and towns good places for wildlife. Gathering evidence of the health and economic benefits (reduced health insurance, reduced flood insurance payouts) makes large investors more likely to see the business sense and therefore invest in the opportunities for income streams from regenerating brownfield sites with biodiversity retained to a worthwhile degree (European Commission, 2022;

Howard, 2020; Merk *et al.*, 2012). From a central and local government perspective, a healthier population means an increased ability to work, and higher productivity leading to increased tax returns.

CONCLUSION

The importance of nature to society through the benefits it provides for physical and mental well-being and infrastructure resilience in the face of climate change is becoming more apparent. However, to realise the benefits, especially in areas with a deficit of good quality greenspace, will require continued investment and at higher levels than present. New funding models will be required, and further robust evidence of the benefits and possible return on investment in order for investment to occur.

The Hamiltonhill Claypits, as part of the wider project, is an excellent example of what is possible, which is reflected in it winning multiple awards, including a Living Waterways Award and a Landscape Institute Award.

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Havoc Meadows and Brucehill Inland Cliff: a proposed Local Nature Reserve, Dumbarton, Scotland

Z. Weir[1]* & I. McLaren[1]

[1] c/o Glasgow Natural History Society, Graham Kerr Building, University of Glasgow, Glasgow G12 8QQ

*E-mail: havocmeadow@gmail.com

ABSTRACT

The Havoc and Brucehill Inland Cliff site is a proposed Local Nature Reserve in West Dunbartonshire, Scotland. It is a 4.5 ha ex-brownfield mosaic of new and recovering old grassland, mature woodland, and wet sandstone cliff. In this contribution, the site is described and its history and natural history are summarised. The encouragingly rapid return to high biodiversity of this site is a reminder of the restoration potential of disturbed habitats.

SITE DESCRIPTION

Havoc Meadow (NS3812975780) is a damp grassland site next to mudflat and saltmarsh within the Inner Clyde Special Protection Area (SPA), West Dunbartonshire, Scotland (Fig. 1). The northern boundary is contained by Brucehill Cliff, which is woodland-fringed, and exhibits a range of conditions and plant communities (Figs. 2 and 3). This cliff, which was once shaped by wave action, features a cave of local historical importance. Between the cliff and the Clyde shoreline sits the main body of the raised beach site. This includes marshy and neutral areas of damp grassland, on various non-natural or altered substrates, and at mixed stages of maturity (Figs. 4 and 5). The site is bisected at a right-angle to the shoreline by Havoc Road.

Fig. 1. Drone view of Havoc grasslands on the Clyde estuary, Scotland, 2022. (Photo: John Rogers)

Fig. 2. Brucehill cliff and woodland corridor, 2021. (Photo: Iain McLaren)

Fig. 3. Bryophytes, ferns and cavelets at the cliff base, 2021. (Photo: Iain McLaren)

Fig. 4. Disused "red blaes" substrate, 2022. (Photo: Iain McLaren)

Fig. 5. Disused council tip and sports pitches, 2022. (Photo: Iain McLaren)

HISTORY

A "Havock Farm" building next to Havoc Road, at the shore end, is marked on maps from the early 19th century to the early 1930s. The land was used for grazing cattle for at least the two decades preceding World War II, and possibly much longer; the alternative local name "The Coos' Park" is still used by a few older residents. "Allotment Gardens" are also shown there on maps from the 1930s. There was a "large colony" of greater butterfly-orchid (*Platanthera chlorantha*) on the land at this time (Futter, 2007). For many years, the species was thought to have been wiped out here by the use of the site as a municipal landfill amenity from 1954 to 1980 by the then Dumbarton District Council (Futter, 2007). From the 1950s to the early 1970s, despite the landfill activity adjacent, the shore was a popular picnicking and bathing site, with a very high footfall in summer.

The origin of the imported soil subsequently used to cover the in-filled areas is not known. A small area of wildflower meadow (at the eastern end) remained unused for landfill, presumably due to the land at this end being part of the old Keil School's estate. In 1980, the areas of buried waste were grassed over for sports pitches, and a red blaes athletics track was installed (Dumbarton District Council, *ca.* 1995) (Fig. 6). Both of the schools using these had closed by 2000, and "variable and…at times *ad hoc* (council mowing)" (Futter, 2007) (Fig. 7) was discontinued in 2013. Regular fire-raising in the early years of this century may have acted as "accidental management" of bracken (*Pteridium aquilinum*) and vigorous grasses (Futter, 2007). While we have seen areas of the red blaes synthetic surface churned up by a council rotavator to hide smaller litter fragments (following a spate of fly-tipping in 2018), it has never been removed, remaining visible today. The shift towards other summer destinations and pastimes since the 1970s has allowed floral and faunal communities on the shore to recover.

The site was recognised in the Leven Valley Habitat Survey of 1992 as a site of importance for wildlife conservation (Futter, 1995). There was an attempt to designate the mature grassland area as a Local Nature

Fig. 6. Red blaes and sports pitches at Havoc, 1985. (Photo: James Connolly)

Fig. 7. By 2007, mowing of grassed areas was sporadic. (Photo: Gillian Neil)

Reserve (LNR) in 1994 under the name "Brucehill Cliff LNR" (Futter, 2007), but this was never made official, due to some error in paperwork which may never be explained (S. Futter, pers. comm.). The late naturalist Dr Keith Futter, and his wife, Su Futter, who were local residents and respected members of Glasgow & South West Scotland Branch of Butterfly Conservation, both knew the site well and recognised its conservation potential. They continued to seek LNR status for the site, and the area was made a Local Nature Conservation Site (LNCS) in 2015 by West Dunbartonshire Council (WDC).

A local community group, Friends of Havoc Meadows (FoHM), was established in 2018 to encourage bio-recording and conservation. Volunteers also worked with the council to remove fly-tipping and litter from the site, which is now kept litter-free by the same coordinated effort. This latter achievement has meant that organised "forest learning" sessions for local school and nursery children, and other community groups, have recommenced in the blaes copse.

From the following year (2019), the site continued to be more actively managed by the Council's Greenspace Department, who ran group sessions to add to the work already underway by bio-recorders. The baseline site species list having been refreshed, an autumn cut and bail was trialled in October 2020, under the continued supervision of Gillian Neil, who in that year moved from her Ranger post to become the area's first Biodiversity Officer.

During the Covid-19 pandemic lockdowns of 2019, the site saw increased footfall from locals; it remains well-used by dog-walkers.

In March 2022, as a result of a community-led campaign assisted by a local councillor, a Tree Preservation Order (area) was granted for around 100 trees at the cave end of the clifftop. Around 30 of these were subsequently felled by developers, who have since been instructed to plant suitable replacements in the same area. At the time of writing, this has not yet been done.

BLAES AND GRASSLAND BIODIVERSITY

Presumably due to its limited porosity, the blaes surface is a dry and apparently hostile environment to many germinating seeds. A sizeable copse of silver birch trees (*Betula pendula*) dominates, surrounded by patchily bare, sun-warmed areas dominated by low-growing wildflowers such as bird's-foot trefoil (*Lotus corniculatus*). This is a surprisingly deep-rooted species, presumably enabling it to cope with the lack of rainfall penetrating the blaes surface. The flourishing of the latter has benefitted the larvae of the common blue butterfly (*Polyommatus icarus*) which feed on it. The open habitat with bare patches is also favoured by the small heath (*Coenonympha pamphilus*). Also well-adapted to the dry open ground is common ragwort (*Jacobaea vulgaris),* providing nectaring opportunities for various Lepidoptera (butterflies and moths) and Syrphidae (hoverflies), as well as the larval food plant for the site's population of cinnabar moth (*Tyria jacobaeae*), which has achieved unprecedented larval numbers on-site this year (2022). Part of this success was due to reduced mowing width of public access paths in areas known to be favoured by these larvae, combined with council and volunteer efforts to promote awareness and discourage ragwort-pulling.

The large area of the former grass pitches is being repopulated by some of the 50 species of grass, sedge and rush found on-site, along with yellow rattle (*Rhinanthus minor*). Six species of Orchidaceae have now staged a return in previously landfilled areas, including common twayblade (*Neottia ovata*), broad-leaved helleborine (*Epipactis helleborine*), and the greater butterfly-orchid (*Platanthera chlorantha).*

The surviving old meadow area remains the most biodiverse for wildflowers, with an abundance of meadowsweet (*Filipendula ulmaria*), hemp agrimony (*Eupatorium cannabinum*) and common valerian (*Valeriana officinalis*), as well as various vetches and clovers (Fig. 8). A range of invertebrates shows a predictable richness. Odonata, including golden-ringed dragonfly (*Cordulegaster boltonii*) and common darter (*Sympetrum striolatum*), hunt above the grasslands. There is an extensive range of macro- and micro-moths, including Mother Shipton (*Callistege mi*), which is an indicator of good habitat. Among the numerous ichneumoniids is the giant *Amblyjoppa proteus*,

Fig. 8. Tufted vetch (*Vicia cracca*) and common valerian (*Valeriana officinalis*), June 2021. (Photo: Iain McLaren)

parasitic on the larvae of elephant hawk moth (*Deilephila elpenor*), which is also present.

The site's south-facing aspect, and the natural windbreak provided by the cliff, contribute to a count of 16 butterfly species in the last five years, including some relative newcomers such as the comma (*Polygonia c-album*), first recorded here in 2019. The site has been described as "one of the best sites to see butterflies in South-West Scotland" (Futter *et al*., 2006)

Breeding grassland birds here include grasshopper warbler (*Locustella naevia),* sedge warbler *(Acrocephalus schoenobaenus),* and common reed bunting (*Emberiza schoeniclus*). Mammals include pygmy shrew (*Sorex minutus*), stoat (*Mustela erminea*), and common vole (*Microtus arvalis).*

BRUCEHILL CLIFF AND WOODLAND BIODIVERSITY

Brucehill Inland Cliff, a red sandstone cliff bordering the site, formerly a sea cliff but now abandoned after a fall in sea level, is a key local geological feature. It was laid down by wind in arid desert conditions in the Devonian period (375 million years ago). Cross bedding can be seen at the base in some parts (Fig. 7). The action of waves on the cliff has carved fissures and cavelets, the largest of which is Wallace's Cave (also known as Havoc Hole) (Fig. 9). Wide enough to admit only one abreast, measuring 3.7 m in height at the entrance, it is possible to walk upright, on uneven ground, for a few feet. From therein onwards, both the height and width diminish rapidly as the cave deepens. Measured from the cliff face, beneath the edge of the overhang, using a long pole, we found the cave to be 13.8 m deep on 1st October 2022. The high humidity and low light levels of this cave are well-suited to a presumably small, but stable, colony of the European cave spider (*Meta menardi*). The white, tear-shaped egg-sacs of this species can be seen hanging from short threads attached to the cave roof.

Invertebrates on the cliff remain largely undocumented, as do woodland fungi at its base. Parts of the cliff surface drip with water runoff, even during prolonged dry spells. They are covered in bryophytes and at least eleven species of fern, including a large colony of royal fern (*Osmunda regalis*) (Fig. 10). The cliff plant community in other areas – including heathers, ferns, opposite-

Fig. 9. Iain McLaren measuring Havoc Hole, also known as Wallace's Cave, October 2022. (Photo: Zoe Weir)

Fig. 10. Permanently flushed area of cliff, with royal fern (*Osmunda regalis*) in foreground. (Photo: Iain McLaren)

leaved golden saxifrage (*Chrysosplenium oppositifolium*) and greater wood-rush (*Luzula sylvatica*) – indicates acidic rock and soil (Futter, 2007), while various trees have rooted on the cliff-ledges, sometimes with aerial roots extending vertically many feet down along rocky surfaces to reach soil.

Among the less commonly recorded invertebrates inhabiting the damp woodland at the cliff's base are the harvestman *Nemastoma bimaculatum,* and the wet flat-backed millipede (*Craspedosoma rawlinsii*). Also thriving here is a fairly recent Scottish arrival the six-spot comb-footed spider (*Rugathodes sexpunctatus*), a small boreal theridiid found in North America and Russia, which was recorded for the first time in Scotland in 2012 at the Necropolis in Glasgow (R.B. Weddle, pers. comm.). Along the base of the cliff are occasional small marshy areas and stands of bramble.

Eye-catching invertebrates found along the clifftop tree corridor include the speckled wood butterfly (*Pararge aegeria*), tree bumblebee (*Bombus hypnorum*), pseudoscorpion *Neobisium carcinoides* and the harvestman *Megabunus diadema*. A full complement of woodland bird species is found here, including great spotted woodpecker (*Dendrocopos major*), blackcap (*Sylvia atricapilla*), nuthatch (*Sitta europaea*), willow warbler (*Phylloscopus trochilus*), and goldcrest (*Regulus regulus*). Benefitting from the continuous vertical corridor of oak canopy from the clifftop to the grassland oaks below is an established colony of the purple hairstreak butterfly (*Favonius quercus*), a widespread and sometimes common species often overlooked due to its high-flying, typically evening, flight habits.

SHORE BIODIVERSITY

The ecology of the proposed LNR cannot be separated from that of the adjacent tidal estuary, though the latter is not included in the proposed reserve area. It is rich in coastal plants, driftwood and seaweeds. From the high-water mark to the grassland border there is an especially high diversity of flora, as the salt-tolerant floral community mingles with damp grassland species. There are surely specialist invertebrates here yet to be recorded. Among the nationally scarce but locally abundant species here are flowering plants such as sand leek (*Allium scorodoprasum*), and the large amber snail (*Succinea putris*), both of which are also found in some damp areas of the grassland site. Below the high tide mark, there are areas of the super-habitat forming photo-synthesisers dwarf eel grass (*Zostera noltii*) and eel grass (*Z. marina*) in the intertidal and subtidal respectively. This stretch of shore is a great place to see waterfowl in large numbers, particularly in the winter when it is an important feeding ground for various wading birds.

FUTURE PLANS

The current proposed LNR area, under a revised name still under discussion, is larger than the previous iteration, encompassing wooded areas and fields on both sides of Havoc Road. It is the intention of the Biodiversity Officer and the Greenspace Department to apply for full LNR status for this site in the near future.

The principal aspect of the current management plan is that a cut and bail will be done annually in immature areas, and on a three-year rotation in mature areas, with clippings collected to ensure impoverished soil. Council staff plan to control the spread of bracken (*P. aquilinum*) in some areas, although it is considered useful on the sloping south-eastern end of the cliff. Efforts to remove Himalayan balsam (*Impatiens glandulifera*) by volunteers since 2018, and increasingly supported by council efforts, have partially succeeded. The plant had first arrived on-site in 2004 (Futter, 2007), but by 2017 had become well established on three of the site's four borders, beginning to "jump" into the central area in

places. A patch of Japanese knotweed (*Fallopia japonica*) persisting beneath the cliff since 1995, and scattered specimens of *Rhododendron ponticum,* have also been mapped for removal, although the latter is mostly growing from inaccessible crevices high in the cliff face. Re-introduction on the bracken slope of common violet *Viola riviniana* (once the eradication of *I. glandulifera*, which has out-competed it, is complete) would then be possible.

CONCLUSIONS

Havoc is an encouraging example of the importance of brownfield sites for biodiversity, particularly when properly managed. The creation of site-specific volunteer group, and sustained contributions from bio-recorders, appear to have encouraged council effort and investment. The ecology of the site, as well as its high level of local support and beneficial recreational and educational use, would seem to indicate that LNR status would be appropriate.

The "Friends of Havoc Meadows" group welcomes additional members to assist with the weekly transect for Butterfly Conservation, take part in occasional group biological recording sessions, or contribute to light practical conservation tasks such as Himalayan balsam control. ZW is the group administrator. A frequently updated list of all recorded taxa at Havoc is available at www.gnhs.org.uk/biodiversity/Havoc_splist.pdf.

ACKNOWLEDGEMENTS

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Biological recording at Hamiltonhill Claypits Local Nature Reserve, Glasgow, Scotland

E. Plant[1] & C. de Lima Hutchison[2]

[1]Geographical and Earth Sciences, University of Glasgow, Glasgow G12 8QQ
[2]22 Spiers Wharf, Flat 18, Glasgow, G4 9TB

[1]E-mail: e.plant.1@research.gla.ac.uk

ABSTRACT
Hamiltonhill Claypits is a popular Local Nature Reserve, situated in the north of Glasgow. The mosaic of habitats at the site has given rise to a plethora of species (766 species recorded as of December 2022), with ecological monitoring of the site taking place from 2001. In 2021, the site reopened after infrastructural work, and species recording has continued with renewed vigour. This paper briefly describes the habitat mosaic of the Claypits, previous recording that has taken place there, and plans for future recording by the recently established Ecological Working Group.

INTRODUCTION
Hamiltonhill Claypits, Glasgow, Scotland was first established as a Local Nature Reserve (LNR) in 2016, and work to improve the accessibility of the site was completed 2021, thanks to European funding assigned via the Green Infrastructure Fund, details of which can be found in Faulkner (2023). As a green space that was already much-loved by community members and naturalists, the improvement works to the Claypits facilitates a wider community use, helping to reconnect people with nature. Located along the Glasgow Branch of the Forth and Clyde Canal, the Claypits opens up routes for active travel as well as preserving space for nature to thrive. Biological recording at the site has been carried out since 2001, and more recently (beginning in 2022), an Ecological Working Group (EWG) was set up to continue recording species at the site. The EWG is organised as a subgroup of the Hamiltonhill Claypits LNR Management Group, and comprises a small number of volunteers that regularly visit the site and have some knowledge on specific taxon groups that inhabit it. The involvement of the EWG at the site helps to run species surveys, events and social media that relays the group's work to the local community. Here we give an account of previous ecological monitoring at the Claypits, as well as along the canal itself from the bridge at Firhill Road to the Applecross Basin, including the towpath on the west side (Fig. 1). Furthermore, we describe the mosaic of habitats that comprise the Claypits and outline the future monitoring plans of the site by the ecological working group.

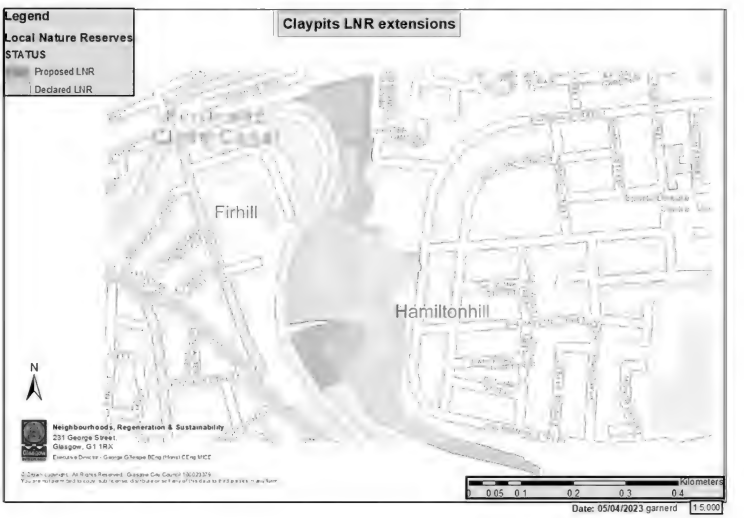

Fig. 1. Claypits LNR, Glasgow, Scotland and proposed extension. (© Open Street Source)

HABITAT

The Claypits is composed of a mosaic of habitats (Fig. 2A), which supports rich floral communities. The formation of different habitats over a short geographical distance is a common characteristic of brownfield sites, resulting from years of perturbation and human pressures (Mathey *et al.,* 2015). Moreover, lack of management and release from disturbances means that vegetation in brownfield sites is often in different successional stages (Macadam *et al.,* 2013). The industrial history of the Hamiltonhill area of Glasgow and of the Glasgow Branch of the Forth and Clyde Canal are described by Faulkner (2023), with the historical disturbance to the Claypits habitat largely arising from the removal of clay from the site (Faulkner, 2023). Furthermore, the industrialised use of the land in the surrounding area such as the iron works (Faulkner, 2023), has contributed to the high iron content found in the soils on site. More recently, infrastructural works to the site, which include path formalisation (Fig. 2B), have contributed to the disturbance pressures at the site. The introduction of such paths has increased habitat fragmentation and further promoted the mosaic pattern of habitats. Fig. 2A shows the diversity of habitat at the Claypits which includes mixed woodland, scrub, neutral and acidic grassland. Biodiversity in the area also benefits from blue infrastructure, in the form of the Forth and Clyde Canal.

BIORECORDING HISTORY

The Claypits would have been surveyed in the 1980s as part of The Changing Flora of Glasgow Project (Dickson *et al.*, 2000), but the species were recorded by tetrad so cannot be ascribed to individual sites. Thus, the first known biodiversity records for the site are from a Phase 1/Phase 2 Habitat Survey in 2001 which formed part of a project run by the Scottish Wildlife Trust (D. Herd & N. Dadds, unpublished report for Scottish Wildlife Trust, 2001). The report listed 203 taxa, of which 187 were botanical, with a few amphibians, insects, mammals, and birds, in the "Westercommon Community Woodland" which was the former name of the site. The report recommended the site as ideal for a community conservation project.

However, there is little evidence of further bio-recording until a public event called "Bats, Beasties and Buried Treasure" in 2011. It was repeated in a couple of subsequent years, but its principal effect was to stimulate regular recording by local naturalists. Thus, in 2012 there was a field excursion by Glasgow Natural History Society (GNHS) members, and a survey of terrestrial molluscs by a specialist. GNHS members continued to visit in succeeding years, adding to the bird and insect records in particular.

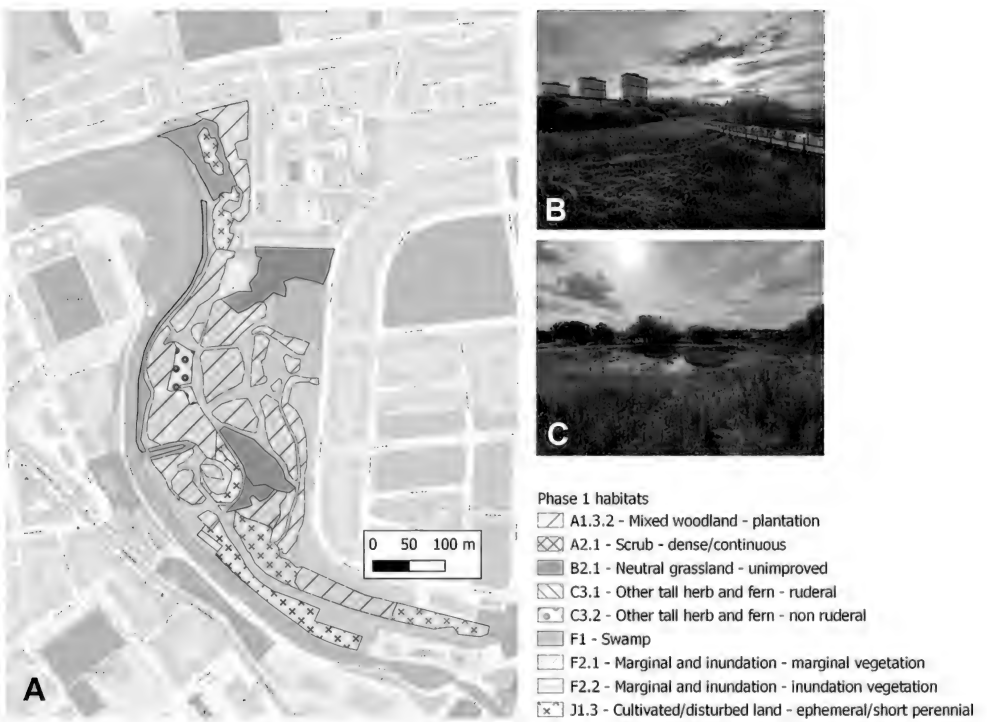

Fig. 2. Claypits LNR, Glasgow, Scotland. (A) Map of the Phase 1 Habitat Survey conducted at the Claypits in July 2022 by CdeLH. (B) North part of site, showing new boardwalks. (C) Sustainable drainage system (SuDS). (Photos: Cathel de L. Hutchison)

In 2013 a further report was commissioned by the Friends of Possilpark Greenspace to inform the habitat management plan for the site (P. Say, Natural Capital Ltd., Edinburgh, unpublished report for Friends of Possilpark Greenspace, 2013). This listed 183 taxa, again mainly botanical, but there were also 30 birds, and nine butterfly species, including an early record of the comma (*Polygonia c-album*) in Glasgow. Further bird and many invertebrate records were added in 2014-2017 by GNHS members and local ornithologists.

An extensive Phase 1 Habitat Survey was carried out in May of 2017 by Land Use Consultants Ltd. This survey classified the habitat types that make up the Claypits, as well as considering the suitability of the site for protected species. Although the survey did not record faunal species, a desk study of the site suggested that otters (*Lutra lutra*), Daubenton's bats (*Myotis daubentonii*), common pipistrelles (*Pipistrellus pipistrellus*), and soprano pipistrelles (*P. pygmaeus*) could potentially inhabit the site due to the habitat present and records of the species in the surrounding area. In fact, the soprano pipistrelle was recorded on the site in 2011 but has not been recorded since, due to the lack of surveys.

In 2018 there was a public event at the Claypits, forming part of city-wide events commemorating the 30th anniversary of the Glasgow Garden Festival, which included displays and recording forays by organisations such as Butterfly Conservation, the Royal Society for the Protection of Birds (RSPB) and FrogLife. A notable find at the event was a marsh pug (*Eupithecia pygmaeata*), which was only the second record of this moth in Glasgow.

Furthermore, 2018 was also the year that the cinnabar moth (*Tyria jacobaea*) first appeared at the site, and adults and caterpillars have been recorded there ever since. Regular moth-trapping in the compound at the north end of the Scottish Canals buildings also started in July 2018. Caddisflies (Trichoptera) and some other insects found in or around the trap have also been identified and recorded.

Little recording was possible during the time the site was fenced-off for the engineering works, and the COVID lockdown further limited visits, though some bird records were made from the tow-path.

There is a regularly-updated list of species that have been recorded in the Claypits area (as defined in the introduction above) on the GNHS website at https://www.glasgownaturalhistory.org.uk/biodiversity/claypits_splist.pdf which also lists the years when each species was first and last recorded.

RECORDING SINCE THE RE-OPENING AND FUTURE RECORDING

The re-opening of the Claypits on 31st July 2021 included a bio-recording event by Friends of Possil Park Greenspace. Additionally, regular Saturday morning walks, as well as ongoing visits by local naturalists have yielded some species sightings. To date, recording events have been sporadic, with some taxon receiving more attention than others.

Botanical surveys in collaboration with Botanical Society of Britain and Ireland recorders in July and August 2021 added a further 70 botanical species which had been absent from previous surveys, including the first recordings of bifid hemp-nettle (*Galeopsis bifida*) and Nuttall's waterweed (*Elodea nuttallii*) on the site. It is likely that some of the additions were from the seed-mixes used in re-seeding bare ground, and others were instead opportunists. Further botanical surveys are planned from 2023 onwards, with the objective of establishing transects and squares to standardize and regularise monitoring.

Local ornithologists have been contributing records for the Claypits via the British Trust for Ornithology's (BTO) project Birdtrack, with a total of 12 species added to the list since 2021, such as the kingfisher (*Alcedo atthis*), the pied wagtail (*Motacilla alba*), and the chiffchaff (*Phylloscopus collybita*). Another notable sighting was a red kite (*Milvus milvus*) in 2019. However, this was not added to the species list as it was only observed flying over the site. In addition, a breeding bird survey (BBS) was conducted in the spring of 2022 in collaboration with the RSPB. This survey recorded 56 pairs of birds across 23 species, including blackcaps (*Sylvia atricapilla*), goldfinches (*Carduelis carduelis*) and cormorants (*Phalacrocorax carbo*). Both the recording via Birdtrack as well as the BBS will contribute to recording in the future, with members of the ecological working group carrying out this work.

Many invertebrates (99 insects, and one harvestman) have been added to the species list since the reopening. Regular moth trapping produced the first Scottish sighting of the orache moth (*Trachea atriplicis*) in July 2022, this being now a rare immigrant in the U.K. Use of the light trap will continue to monitor the moth and caddisfly taxa. Furthermore, a regular butterfly transect was started in April 2022, by a member of the Claypits EWG. Sightings of small copper (*Lycaena phlaeas*) on the site were particularly welcome as this species had not been seen since 2013. An event in July of 2022 called "An Intro to Inverts at the Claypits" was aimed at encouraging people to learn more about the invertebrate species that could be found on site, and gathering enthusiasm within the local community to record these species. At the event ten insect species were added to the species list, such as the painted lady butterfly (*Vanessa cardui*) and the hoverfly species *Volucella pellucens* and *Eristalis nemorum.* The event was successful at enthusing local community members; over 25 local community and GNHS members attended, resulting in several people expressing their interest in getting involved with the EWG.

It has been important to continue recording species at the site after it reopened to the public, as the work on site was thought to have disturbed some habitats. For example, the installation of paths may have disturbed

ground nesting bee species, while works to create a sustainable drainage system (SuDS) pond (Fig. 2C) may have impacted waterfowl nesting opportunities and palmate newts (*Lissotriton helveticus*) at the site, the latter being last recorded in 2018.

Other planned recording activities include a joint excursion with the Clyde and Argyll Fungus Group and members of GNHS in 2023, which will hopefully add more fungi records to the species list. So far only nine species of fungi have been recorded at the Claypits which include turkey tail (*Trametes versicolor*), collared earthstar (*Geastrum triplex*), and sticky scalycap (*Pholiota gummosa*).

As the ecological working group at the Claypits continues to grow, more surveys will be added to the monitoring protocol at the site, focusing on a wider variety of taxa and helping volunteers to improve their identification skills. Furthermore, with funding from GNHS's Blodwen Lloyd Binns bequest, more equipment will be purchased to help improve ecological monitoring at the site. Planned new surveys in 2023 include a DragonflyWatch survey, pitfall traps for ground dwelling invertebrates, dawn and dusk bat surveys, and mammal surveys using camera traps and Longworth traps. Details of these surveys will be outlined in the Claypits Ecological Monitoring Strategy, which will be available upon request from the authors of this paper. Furthermore, there are plans to join with local groups such as Clyde Bat Group and Clyde Amphibian and Reptile Group, in order to host training or surveying events which will provide the local community with a chance to be involved with bio-recording on the site. Finally, another future aspiration of the EWG is to carry out bryophyte surveys on site with help from experts in this field.

CONCLUSION

The species list for the Claypits has grown dramatically since the first known records for the site in 2001. Furthering species recording at the Claypits through the use of systematic protocols is a key aim of the EWG. By combining some surveying sessions with events, the hope is to involve the local community in recording, helping them to improve their species identification skills whilst in turn learning from them as individuals who are regularly at the site. Furthermore, other recording groups with specific expertise are invited to record species at the site, and GNHS are likely to include the Claypits on their 2023 summer field excursion list. Whilst sightings from community members and groups are welcome, having standardised recording methods that are carried out by a core group of people will allow research grade data to be collected and compared. Overall, recording will help to inform future management of the site, including the invasive species control and targeted planting of trees and shrubs.

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We would like to thank: Richard Weddle and Glasgow Museums Biological Records Centre for information about the history of biological recording at the Claypits, and for the species list; members of the Claypits Management Group, volunteers and all those who have taken part in recording events at the site; and Scottish Canals for their interest and support.

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Malls Mire Community Woodland: restoring biodiversity on a brownfield site, a green infrastructure project in Glasgow, Scotland

N. Digruber

Toryglen Community Base, 179 Prospecthill Circus, Glasgow G42 0LA

E-mail: nicole@urbanroots.org.uk

ABSTRACT

Malls Mire Local Nature Reserve, Glasgow's first community woodland, is an interesting case study of a project that is aiming to impact all the pillars of sustainability, especially environmental protection and social equity through a community-led approach. Situated within the Toryglen area in the south of the city, the site has a varied history of agriculture, forestry, golf, and industrial development. It also has a legacy of associated pollution and dumping of waste materials. Urban Roots, the charity involved in the management of the site, has worked alongside Clyde Gateway and Glasgow City Council on a green infrastructure project. Funded through the European Regional Development Fund Green Infrastructure programme, administered through NatureScot, with additional resources from Sustrans, it has enabled large scale improvements at Malls Mire. The work which began in 2020 has connected greenspaces throughout Malls Mire, brought derelict land into positive management and also saw new Sustainable Drainage Systems ponds installed on site. The wide range of resulting benefits include improved access, increased personal safety, shared-use paths, better lighting, opportunities for outdoor recreation, education and volunteering as well as enhanced habitats and benefits for biodiversity and climate change adaptation.

INTRODUCTION AND HISTORY

Located in the Toryglen district of south Glasgow, the Malls Mire Community Woodland is nestled between the Polmadie Traction and Rolling Stocks Maintenance Depot (TRSMD) and several residential areas (Fig. 1).

The high water-table indicates that the area has been a mire at least in the recent past, although not much is known about the history of the site prior to the 1850s.

The Ordnance Survey (OS) map of 1859 (Ordnance Survey, 1859) shows Malls Mire lying between two farms, Blackfaulds to the east and Toryglen in the west. At this point, much of the eastern part of the site was a managed woodland, containing conifer and broadleaf plantations. To the west lay fields surrounded by wooded boundaries. According to the OS survey maps, the woodland had disappeared by the 1890s (Ordnance Survey, 1893), with the whole area having been converted to fields. The first

Fig. 1. Aerial view of Malls Mire (arrow), Glasgow, Scotland. (Image: Google Maps)

sign of a pond appeared on maps from 1910 and by 1930 the area was void of trees and the adjacent farmland was transformed into Toryglen Golf Course and the old farm house was turned into the club house (Ordnance Survey, 1936). By the 1950s, both farms as well as the golf course had disappeared from the maps (Ordnance Survey, 1956). The ground levels appear to have been altered in the north-eastern corner of the site, through the deposition of industrial waste, possibly in relation to the extension of the railway line and the necessary removal of the road bridge that used to lead across it. The outline of the pond, which now was larger, had also been altered.

In the 1990s, several botanical surveys were undertaken and Glasgow City Council (GCC) designated Malls Mire as a Site of Importance for Nature Conservation (SINC) in recognition of the importance of the wetland site within the region. 1993 saw the afforestation of the eastern part of the site and this has resulted in the creation of the woodland as it can be seen today. The planting design was sympathetic to the integrity of the valuable wetland habitats. As the woodland is maturing it has increasingly become important as a valuable wildlife habitat and also serves an important role as social space.

Urban Roots, a community-led environmental and health improvement charity, has been involved in the management of Malls Mire since 2007, when the first access and habitat improvement projects were undertaken with local residents. Urban Roots is an example of a genuine grassroots organisation, which grew out of the Toryglen Gardening club, and their management aims continue to be for the benefit of the local community and nature conservation. Urban Roots helps people across the south side of Glasgow to connect with nature and to help tackle the causes of climate change and the biodiversity crisis. This is done through weekly woodland conservation groups, community garden plots, and weekly gardening groups, as well as many outdoor and educational events for local families and schools.

In 2015 the Community Woodland and associated open habitats of Malls Mire, an area of 8.5 ha, were designated as a Local Nature Reserve (LNR), with a proposed extension planned for 2023. The extension will include areas of wetland, swales, grassland and more woodland at the Polmadie community plots (Fig. 2).

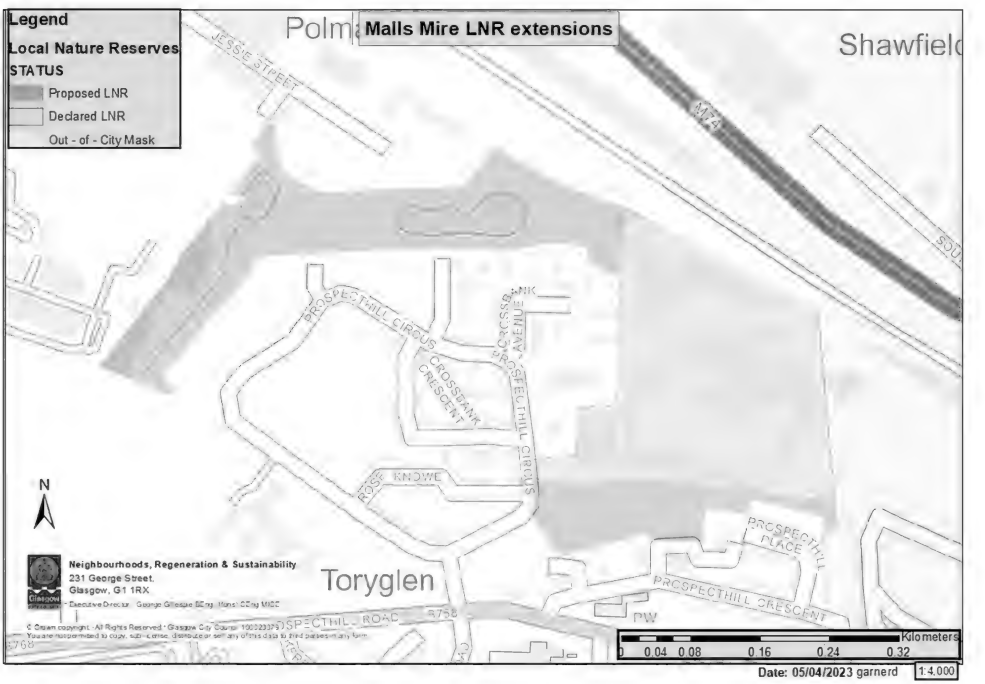

Fig. 2. Proposed Malls Mire LNR extension. (© Open Street Source)

GREEN INFRASTRUCTURE PROJECT

North Toryglen estate was built in the 1950s and 1960s by GCC and was part of a wider ambition to build residential tower blocks in an effort to clear inner city overcrowded Victorian tenements. As these buildings fell out of favour due to high levels of crime and the poor living standards associated with them, demolitions started in the 1990s and 2000s.

In 2011, a team was commissioned to design a regeneration project for North Toryglen, which was one of eight areas identified as Transformational Regeneration Areas (TRAs) within the City of Glasgow. Work on new housing began in 2014 and Urban Roots started working on a Green Infrastructure Engagement Fund project in 2018. Following a comprehensive community consultation, a master plan was developed, taking into account local residents' hopes for the area. Consultants from Land Use Change (LUC) worked on the design for the Malls Mire Park.

The project linked a further 16 ha of greenspace to the existing Malls Mire Community Woodland, enhancing not only the value for biodiversity but also for the local community as it transformed the area from a derelict site, filled with litter and safety concerns, into a thriving greenspace for local communities to connect with nature, play, exercise and to spend quality time in.

The multiple benefits of this green infrastructure project include mitigation and adaptation to climate change, protection against flooding through the use of Sustainable Drainage (SuDS) ponds, improved habitats and connectivity to support biodiversity, as well as the improved quality of life for the communities surrounding Malls Mire.

Throughout the project, work continued in the community woodland, where weekly volunteering sessions ensure the habitat is maintained and the woodland is accessible. Among other things, the volunteers clear and maintain paths, create and maintain wildflower meadows through planting and scything, remove invasive species, coppice willow and pick litter as and when required. In addition to these tasks, the volunteers have had training in traditional hedge-laying practices, which enables them to work on two stretches of hedge, thereby improving them as habitats for birds and other wildlife, as they are now much denser and offer more protection and foraging opportunities.

The green infrastructure project has enhanced the opportunities for the delivery of a variety of community engagement and education programmes. A scheme to adopt a plot at the Polmadie community garden was set up and several after-school and holiday clubs were held throughout the year, which included Urban Explorers and Into the Woods children's clubs. These were very popular and the aim is to continue these in the future, alongside the continued support for local primary school classes to achieve their John Muir award.

BIODIVERSITY

Malls Mire was recognised for its value for biodiversity early on (Figs. 3 and 4), beginning with the designation as SINC based on botanical surveys in the 1990s and later on when it was designated as LNR in 2015. As of January 2023, 414 species have been recorded on site, with several notable species for the area such as the bronze shieldbug (*Troilus luridus*), which was a first for the Clyde region.

Fig. 3. Common spotted orchid (*Dactylorhiza fuchsia*). (Photo: Urban Roots)

Caledonian Conservation was commissioned by Urban Roots in 2014 to conduct an invertebrate survey of Malls Mire (Cathrine & Norris, 2015). They recorded 174 species, including a nationally scarce spider, the southern motherphage (*Coelotes terrestris*) in good numbers, and focused on the community woodland and associated open habitats on the eastern side of the site.

Some notable bird species on the list of U.K. Birds of Conservation Concern 5 (BoCC5) (Stanbury *et al.*, 2021), have been recorded at Malls Mire. These include the ringed plover (*Charadrius hiaticula*) recorded in 2018 (GNHS, 2023) and the herring gull (*Larus argentatus*) in 2021, both of which are on the Red List. Sightings from birds on the BoCC5 amber list include the mallard (*Anasplatyrhynchos*), woodpigeon (*Columba palumbus*), reed bunting (*Emberiza schoeniclus*), kestrel (*Falco tinnunculus*), meadow pipit (*Anthus pratensis*), dunnock (*Prunella modularis*), moorhen (*Gallinula chloropus*) and wren (*Troglodytes troglodytes*). Several species that are on the Glasgow

Fig. 4. Tree bumble bee (*Bombus hypnorum*) pollinating a wild cherry (*Prunus avium*). (Photo: Urban Roots)

Local Biodiversity Action Plan (Glasgow City Council, 2001) were also recorded. These include the common frog (*Rana temporaria*), the reed bunting, and the only two species of Odonata recorded on site, the large red damselfly (*Pyrrhosoma nymphula*) and the common darter (*Sympetrum striolatum*).

Several species of moth found on the Scottish Biodiversity list (NatureScot, 2020) have also been recorded, such as the powdered quaker (*Orthosia gracilis*) and the shaded broad-bar (*Scotopteryx chenopodiata*). A butterfly transect was set up in 2022 with the help of Butterfly Conservation, but due to a lack of volunteers only a few species were recorded, including the small heath (*Coenonympha pamphilus*). There are plans in place to re-start the weekly transect butterfly work from April 2023, and to increase the number of volunteers in an effort to collect more records.

Glasgow Museums Biological Records Centre (Glasgow Life) holds records of all the sightings at Malls Mire, from which a regularly-updated species list is produced (Glasgow Natural History Society, 2023).

In addition to individual species of conservation concern, the site also features several priority habitats from the Glasgow Local Biodiversity Action Plan, and the U.K. Biodiversity Action Plan list: wet woodlands, ponds and hedgerows. These habitats have been identified as being the most threatened and in need of conservation action.

Wet woodlands are commonly found on poorly drained soils that are seasonally wet and are usually dominated by alder (*Alnus* spp.), birch (*Fagus* spp.) and willow (*Salix* spp.) species, often showing a history of coppicing. These woodlands are important for many taxa and due to the high level of humidity favour bryophyte growth (JNCC, 2016). There are also many invertebrates associated with the main tree species found there, including craneflies (Tipulidae). This makes it noteworthy that few have been recorded, with a future aim to record more the on site.

Ponds are a valuable habitat for biodiversity and also provide important ecosystem services, such as flood water regulation and carbon sequestration. In the U.K., ponds have suffered severe declines in the past century and they continue to face threats from pollution, urban expansion and agricultural land drainage (Wood *et al.*, 2003). In addition to a pond within the community woodland, Malls Mire also has SuDS ponds, which have been designed to manage stormwater (Fig. 5). There has been research to show that they can be beneficial for biodiversity (O'Brien *et al.*, 2019). Surveys of the woodland pond as well as the SuDS ponds are planned for 2023, as there is a lack of current data about these ecosystems.

Fig. 5. SuDS pond and wetland area. (Photo: Urban Roots)

The third priority habitat that can be found at Malls Mire is hedgerows. There has been a decline of hedgerows in Scotland, but these habitats are very valuable for wildlife, such as birds, mammals and butterflies, as they can provide a source of food and shelter, and are also important habitat corridors. The hedge along the eastern side of the site was transformed through traditional hedge-laying techniques by a group of volunteers to further increase its value for biodiversity through increased shelter opportunities. Additional planting of hedges will form part of the ongoing management plan of the site to further expand this habitat.

In addition to beneficial species and habitats, Malls Mire also hosts invasive non-native species such as Japanese knotweed (*Fallopia japonica*). A survey was carried out by Urban Roots in 2019 to inform the green infrastructure project, but records of this plant go back to 1984 (GNHS, 2023). The main stand of Japanese knotweed is found on the northern boundary with the railway line and work continues to ensure that it does not spread. Another invasive species present at Malls Mire is *Cotoneaster horizontalis*, which has spread throughout the community woodland. Volunteers have spent time in 2021 to remove some of the plants. As it forms part of the limited understorey of the woodland, the remaining stands have been left to ensure the

integrity of the overall woodland structure until further understorey growth by native plants can be encouraged.

Future plans for Malls Mire not only consist of practical conservation tasks such as scything meadow areas (Fig. 6), coppicing, planting of native species and the removal of invasives, but also include a renewed focus on biodiversity recording, especially for the taxa where records are lacking, such as fungi, Odonata, molluscs, craneflies and aquatic invertebrates. A moth survey is also planned for 2023 as only limited surveys have been possible due to the urban location of the site and the consequent possibility of vandalism. Another invertebrate survey, including the areas of the planned LNR extension, would be beneficial, and plans are in place to secure funding for it.

Fig. 6. Volunteers scything the meadow areas of Malls Mire. (Photo: Urban Roots)

CONCLUSION

Malls Mire has demonstrated that transformation of a previous derelict and unsafe area to a community woodland can have multiple benefits for the environment as well as the local community. This is especially the case when the project is designed and run with meaningful input of residents. Future aspirations for Malls Mire include a continuation of the work with the community. Urban Roots plans to build on their work to connect people with nature for the benefit of the environment as well as the community. This will include more citizen science projects, increased recording of species found at Malls Mire, from fungi and amphibians to butterflies and invertebrates. A bioblitz in collaboration with the Glasgow Natural History Society and other partners is also planned for the future.

Working in partnership with local GPs and "green prescribing" (recommending visits to the places like this as part of treatment) is another way in which Malls Mire is aiming to help people improve their mental health through nature-based activities and interventions. Continued efforts are on their way to engage with the young people of the area to provide opportunities for outdoor activities, learning and employability skills. The aim is to provide a year-round youth programme to achieve this.

Urban Roots plans to focus on evidence-based woodland and site management to maintain and enhance the biodiversity benefits of the site, while generating opportunities for volunteering and nature-based art and crafts activities. The planned extension for the LNR is the next step in ensuring positive management of the site for nature and people. A craft willow coppice is planned alongside the existing willow and hazel coppice areas, as well as the planting of more fruit bushes for foraging and the expansion of the network of hedges. There are also plans to have more interpretation and community art installations on site to better relate the site to its visitors and to tell the story of Malls Mire. Linking up with other community woodland groups to exchange learning and best-practice ideas is also planned for the future of Malls Mire in an effort to continue to work on the sustainability of the site.

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Anthropogenic biodiversity and geodiversity: investigating the potential for legacy anthropogenic substrate sites to help offset falling global biodiversity

S.N.K. van Mesdag

School of Geographical and Earth Sciences, University of Glasgow, Glasgow G12 8QQ

E-mail: s.van-mesdag.1@research.gla.ac.uk

INTRODUCTION

Anthropogenic substrates are produced as waste materials and/or by-products of a variety of industrial processes. Blast furnace/steel slag, oil shale spoil, colliery spoil and paper mill sludge are just some of the anthropogenic substrates that can be found dumped in the natural environment in areas previously associated with industry (Thomas, 1930; Bradshaw, 1977; Allan *et al.*, 1997; Saether *et al.*, 2004; Courtney *et al.*, 2009; Woods, 2012 ; Piatak *et al.*, 2015; Butt & Briones, 2017; Di Carlo *et al.*, 2019; Gomes *et al.*, 2019).

Traditionally, brownfield land has been altered and/or viewed in the context of unsightly, derelict wasteland that ought to be developed or remediated, with no purpose for human wellbeing or biodiversity unless changed (Gemmell, 1976; Richardson *et al.*, 2010; Mathey *et al.*, 2018). For example, many anthropogenic substrate sites have been capped with clay or similar materials to try to increase plant cover on sites and potentially reduce the spread of contaminants from the substrate (Mayes *et al.*, 2006, 2008; Gorman, 2009; Environmental Protection Agency, 2012). However, it has been found that, if left undisturbed, anthropogenic substrate sites can potentially provide relatively undisturbed spaces for wildlife due to variations in chemistry, surface texture, topography and other factors. In particular, unusual and/or important species communities can colonise and live on anthropogenic substrate sites. Anthropogenic substrate sites can act as refugia for many species and communities, as the chemistry of such substrates can often differ greatly from the chemistry of natural substrates in the surrounding area (Thomas, 1930; Ash *et al.*, 1994; Allan *et al.,* 1997; Bradshaw, 1997; Gibson, 1998; Hitchmough *et al.*, 2001; Harrison & Davies, 2002; Batty, 2005; Bodsworth *et al.*, 2005; Palmer, 2008; Buglife, 2009, 2012a,b; Courtney *et al.*, 2010; Riding *et al.*, 2010; Macadam & Bairner, 2012; Macadam *et al.*, 2013; Robins *et al.*, 2013; Tropek *et al.*, 2013; Woch *et al.*, 2013; Hodecek *et al.*, 2015; Walmsley *et al.*, 2017; Di Carlo *et al.*, 2019; Gomes *et al.*, 2019; Olds, 2019; Kupka *et al.*, 2020; Macgregor *et al.*, 2022).

My research, which began in 2019, involves the investigation of three important aspects of anthropogenic substrate sites: substrate chemistry and mineralogy; plant species and communities; and certain invertebrate species. Various analyses will be carried out to determine the minerals, elements and pH levels present in the different anthropogenic substrates. Various plant communities, as well as the species within them, were recorded in 2021 using quadrats in six study sites, three of these locations being in Scotland and three in northern England. I have been identifying the different species that were recorded, primarily bryophytes, grasses and wildflowers. A range of invertebrate species was recorded in 2021 throughout the three Scottish study sites. These invertebrates include butterflies and moths (Lepidoptera), true bugs (Hemiptera) and bees (Hymenoptera), as well as others from a range of taxonomic groups. In the context of the current biodiversity crisis, it is more important than ever before to record and assess the biodiversity of places, especially if such places tend to be overlooked in terms of biodiversity potential. Additionally, very few studies have investigated the relationships between plant species and the mineralogical and elemental composition of their growth substrates. This work will help with the investigation of plant establishment, survival and growth on anthropogenic substrates in a novel manner.

AIMS AND QUESTIONS

The primary aims and questions of my research are as follows:

1. What influence do substrate types have on plant species distributions?
2. How might anthropogenic substrates on field sites influence the invertebrate species and functional groups present?
3. How does substrate clay capping influence vegetation?
4. What is the influence of variability in steel slag substrate chemistry on plant species distribution?

These aims and questions concern different aspects of the substrate chemistry and wildlife present on brownfield sites. In particular, the investigation of steel slag sites is valuable as these areas are understudied compared with other types of wildlife sites in the U.K. (Ash *et al.*, 1994; Skelcher, 2014; Gomes *et al.*, 2019; Riding *et al.*, 2020). It is expected that the investigation of substrates, plant species, plant communities and invertebrate species on anthropogenic substrate sites will yield information about these sites that will be valuable for a variety of researchers, conservationists and land managers, as well as members of the general public.

METHODOLOGY

Prior to fieldwork on anthropogenic substrate field sites, I acquired related and/or specific knowledge about relevant substrates, plant species and invertebrate species through literature searches, botanical and entomological training. This was done so as to make my independent fieldwork easier and better informed.

I carried out plant-related and substrate-related fieldwork at six study sites in the U.K., three in north-west England and three in central Scotland. The names and locations of these sites are listed in Table 1. Additionally, invertebrate-related fieldwork was completed at the three Scottish study sites; such surveys were not carried out on the English sites due to time and travel constraints. North-west England and Central Scotland have, historically, been centres of many types of industry (Price, 1983; Allan *et al.*, 1997; Palmer, 2008; Warton Mourholme Local History Society Book Group, 2009; Skelcher, 2014; Riley *et al.*, 2020). These sites were chosen to represent a wide range of substrate types and different geographies and topographies.

In preparation for plant-related fieldwork and data collection, a wooden 1 x 1 m quadrat, with 16 10 cm squares within the quadrat (marked out with rope), was made. This was used for the recording of plants at each of the six field sites. The fieldwork took place between 15th March and 31st July 2021. More specifically, plant-based fieldwork in the English sites took place between 10th and 21st July 2021, whilst Scottish plant-based fieldwork took place in March, May and July between 15th March and 31st July 2021. Field trips at the English sites were condensed into one visit due to time and travel constraints. Preliminary visits were carried out to scope each site and to determine the open plant communities, which would be surveyed, rather than the shrubby or forested plant communities, which have not been examined in the research. It is worth bearing in mind that this analysis did not determine plant communities using the traditional National Vegetation Classification (NVC) method, as I wanted to examine more specific species assemblages for the purposes of the study, and NVC communities are often a poor fit and not representative for many anthropogenic substrate sites (Maddock, 2010; Lush *et al.*, 2013). In the field, the quadrat frame was placed on the ground once for each of the plant communities, with plant species recorded in that quadrat frame being deemed to be representative of the communities as a whole. Plant species, including bryophytes, ferns and angiosperms, were recorded. For each quadrat, plant species were recorded using videos captured on a mobile phone, which also included audio of plant community descriptions and lists of different species, as well as numbers of individuals. Certain specimens were also taken from the field and stored in scrapbooks on-site and off-site for later verification, identification and photography, where identification was not possible in the field with the limited time available.

Invertebrates were recorded at the three Scottish sites between the 23rd April and 19th September over 36 separate visits, twice each month (up to 14 for each site). This period of time was chosen to maximise the number of invertebrates that are likely to be recorded during the year. For every month, 2.5 h (±15 min) was spent looking for and recording invertebrates at most of the sites, including on the open plant communities that were also surveyed for plants, as well as the more shrubby and forested areas of the site. A mobile phone was used to record video, audio and location data relating to the different invertebrate records. Many invertebrate specimens were collected on-site to be more easily identified after fieldwork. These specimens were stored in a freezer shortly after each fieldwork trip. Additionally, during each two-monthly site visit, four pitfall traps were placed for 24 h (±15 min) in different parts of the site, placed in (1) different parts of the site and (2) differently shaded and exposed parts of the site. The specimens from these pitfall traps were also frozen shortly after fieldwork trips. The pitfall traps were very simple plastic pots, about 7 cm in diameter and 10 cm in height, which could be sealed with plastic screw-on lids. The bottom of each pot was filled with water and hand sanitiser (containing alcohol; see Simms, 2010; Laub

Site name	Location	Primary anthropogenic substrate/s
Addiewell bing (Scottish Wildlife Trust Nature Reserve) (Fig. 1)	Addiewell, West Lothian, Scotland	Oil shale spoil
Barrow slag bank	Barrow-in-Furness, Cumbria, England	Steel slag (natural clay cover is also present on part of the site)
Fallin bing (Fig. 2)	Fallin, Stirling, Scotland	Colliery spoil
RSPB Hodbarrow Nature Reserve	Hodbarrow, Cumbria, England	Blast furnace slag (much iron-rich sand is also present on-site)
South Bank Wood	Penicuik, Midlothian, Scotland	Paper mill sludge
Warton Slag Bank (part of the Morecambe Bay SSSI) (Fig. 3)	Warton, Lancashire, England	Blast furnace and steel slag

Table 1. Details of the six study sites.

Fig. 1. A view of part of the Warton slag bank, making up a cliff overlooking Morecambe Bay, Lancashire, England. (All photos: S.N.K van Mesdag)

Fig. 2. A view of part of the semi-open habitat on Fallin Bing, on top of the former Polmaise Colliery, Stirlingshire, Scotland.

Fig. 3. A view of a section of semi-open habitat, near scrub and woodland, on Addiewell Bing, West Lothian, Scotland.

et al., 2019) to help to immobilise trapped invertebrates. Unlike pitfall traps in many investigations, these were not covered with additional material in the field: this was partly for convenience but also considered satisfactory considering the fact that the pitfall traps were relatively small and operated for only 24 h, due to the time constraints of the fieldwork.

After fieldwork, specimens were observed and photographed using various equipment including simple microscopes. Soft-bodied specimens were primarily stored in ethanol after observation and photography, and hard-bodied specimens were primarily pinned and stored.

FURTHER WORK

Now that data and sample collection is complete, further work will include analysing the chemistry, mineralogy and elements of the substrate samples, and identifying the remaining unidentified invertebrates and plant specimens. These data will then be used for statistical analyses, primarily if not entirely on R Studio, to attempt to answer the research aims and questions . The results of this work will be presented as a Ph.D. thesis to the University of Glasgow and aspects submitted for publication to refereed journals. The intention behind this paper has been to outline the questions being addressed by the research and the methods being used.

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The Garnock Estuary and Ardeer Peninsula: Scotland's first brownfield SSSI?

B. Philp

7 Glebe Crescent, Ochiltree KA182QP

E-mail: brucephilp47@gmail.com

The area of land around the Garnock estuary and the Ardeer Peninsula (Fig. 1), situated at the mouth of the River Garnock between Stevenston and Irvine, North Ayrshire, Scotland includes a collection of coastal habitats unrivalled in southern Scotland. The interaction between the natural habitats, past industrial modification and 40 years of abandonment has led to a mosaic of habitats unique in Scotland ranging from sandy beach through dunes and salt marsh to grassland, woodland and wetland (see Philp, 2020, Philp *et al.*, 2020 for more details). A collaboration between local naturalists and Scotland's conservation NGOs has submitted a request to NatureScot to designate the whole of the Estuary area a Site of Special Scientific Interest (SSSI) owing to its habitat and invertebrate interest.

Fig. 1. Ardeer peninsula, North Ayrshire, Scotland. (Photo: I. Hamlin)

The site was originally developed for the manufacture of dynamite by Alfred Nobel in the 1870s and eventually became the largest explosives factory in the world, covering 800 ha and employing 13,000 people. The manufacturing processes involved alterations to the topography of the dunes and these have created ideal conditions for thermophilic invertebrates. Across much of the site, dunes have been shaped into tall, steep embankments and encircling blast walls (Fig. 2). Not only do these structures create an extensive network of sun-traps, but their steepness makes them prone to slumping, which creates small clifflets suitable for

Fig. 2. Dune cliff on southern Ardeer peninsula. (Photo: I. Hamlin)

nesting solitary bees and the disturbed ground favoured by plants such as kidney vetch (*Anthyllis vulneraria*), wild thyme (*Thymus drucei*) and Isle of Man cabbage (*Coincya monensis* ssp. *monensis*).

The manufacture of explosives is potentially a highly dangerous process, and many fire ponds were created to deal with any fires or explosions (Fig. 3). These ponds and the associated swamp, mire, and carr habitats now make up one of the largest, most complex and interesting mosaics of wetland habitats in Ayrshire. This area supports breeding wetland birds such as water rail (*Rallus aquaticus*), snipe (*Gallinago gallinago*) and teal (*Anas crecca*), but is especially important for invertebrates such as bees, wasps, dragonflies and beetles.

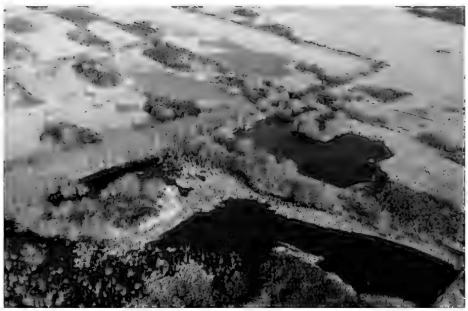

Fig. 3. Garnock East. (Photo: I. Hamlin)

The area contains one of the largest areas of mixed broadleaved and conifer woodland in North Ayrshire including extensive pine woods created for the factory 80 years ago. The abundant dead wood (Fig. 4) in these ageing, unmanaged plantations is particularly important for saproxylic beetles, flies and Hymenoptera, including southern species such as the fan-bearing wood-borer beetle (*Ptilinus pectinicornis*), the weevil *Magdalis duplicata,* the crabronid wasp *Ectemnius ruficornis,* the mason wasp *Symmorphus bifasciatus* and the blue mason bee (*Osmia caerulescens*).

Fig. 4. Dead wood at Garnock West. (Photo: I. Hamlin)

The site also supports many high quality and interesting examples of Open Mosaic Habitat on Previously Developed Land (OMHPDL). Abandoned concrete footprints have developed into classic OMHPDL containing bare ground, high densities of wildflowers, flooded areas and scattered young scrub. The OMHPDL supports many of the same sand dune plants as neighbouring dune habitats (such as common heather (*Calluna vulgaris*) and creeping willow (*Salix repens*)), but also supports large concentrations of many species that are less frequent in other habitats at the site, such as viper's bugloss (*Echium vulgare*) (Fig. 5) and perforate St. John's-wort (*Hypericum perforatum*), adding to the peninsula's habitat diversity.

Fig. 5. Viper's bugloss (*Echium vulgare*) at Garnock west. (Photo: B. Philp)

The site is particularly important for its nationally important assemblage of invertebrates, including a large number of Red Data Book, rare and scarce species. The site contains many rare insects that are at the northern limit of their range in the warm brownfield and sand dune habitats at Ardeer, including the polyester bee *Colletes fodiens* (Fig. 6), the crabronid wasp *Oxybelus mandibularis*, the red longhorn beetle *Stictoleptura rubra*the hoverfly *Eumerus sabulonum*, and the hister beetle *Hypocaccus rugiceps* (Fig. 7). Two of the species at the northern limit of their range at Ardeer, the leaf-cutter bee *Megachile maritima* and the ground beetle *Harpalus neglectus*, are known in Scotland only from this site. The peninsula also supports a range of northern rarities, such as the crabronid wasp *Crossocerus leucostomus*, the mining bee *Andrena ruficrus* and the polyester bee *C. floralis* (Philp, 2020; Philp *et al*., 2020).

Fig. 6. The polyester bee *Colletes fodiens*. (Photo: I. Hamlin)

Fig. 7. The hister beetle *Hypocaccus rugiceps*. (Photo: U. Schmidt)

Perhaps surprisingly, the explosives factory played an important role in preserving the site's nationally important biodiversity into the 21st century. Whereas most neighbouring dune habitats were permanently lost to developments such as housing estates, caravan parks and refuse tips, the Ardeer peninsula's dunes were effectively protected from damaging development by the existence of the explosives factory and the constraints on development it created. Many of the factory's management practices promoted biodiversity. For example, to minimise fire risk, gorse scrub was controlled, keeping the site's dune habitats in an early successional state, and the dune grassland was occasionally cut and the arisings removed, resulting in wildflower-rich meadows.

Much of the area around the Garnock estuary has been owned by development companies for some time but, other than sand quarrying (Fig. 8), few large-scale developments have taken place There have, however, been a number of suggestions for developments including housing, a golf course, a marina, a wind farm, an industrial estate and a nuclear fusion reactor. At the moment, other than the area of saltmarsh, no conservation designations are in place for any of the site. NatureScot are currently considering designating all or parts of the estuary area as a SSSI, and a decision is expected during 2023.

Fig. 8. Sand extraction at Ardeer. (Photo: I. Hamlin)

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Fernbrae Meadows Local Nature Reserve: biodiversity on a rewilded golf course in Glasgow, Scotland

N. Digruber

40 Tobermory Road, Glasgow G73 5PP

E-mail: s30070109@student.sruc.ac.uk

Fernbrae Meadows Local Nature Reserve (LNR) is located on the western edge of South Lanarkshire, Scotland (NS61925879). It consists of two distinct areas, a broadleaved woodland in the south, which includes ancient woodland, and the former Blairbeth Golf course in the north, which is considered a brownfield site and is the focus of this article (Fig. 1). For more information about the history of the site see Birkin (2023).

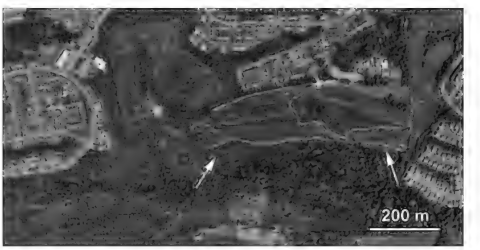

Fig. 1. Aerial view of Fernbrae Meadows LNR, Glasgow, Scotland (arrows). (Image: Google Maps)

In 2018, as part of a project to create a new greenspace, a community consultation took place, which was facilitated by Community Links Scotland. This engagement with people from the areas surrounding the new greenspace ultimately led to the constitution of the Friends of Fernbrae Meadows group in 2019. The aims of the group were identified over several meetings and workshops and include biodiversity conservation, community engagement and community gardening.

The Friends group has worked alongside the South Lanarkshire countryside rangers to arrange and facilitate a wide variety of community engagement events that are linked to conservation aims of the site. In 2019 volunteers sowed a wildflower meadow, for the benefit of both pollinators and visitors, and every autumn they return to collect seeds to enable the creation of new wildflower meadow patches elsewhere on the site. They have also planted appropriate native flowers around the margins of new wetland areas and work to remove invasive plants like Himalayan balsam (*Impatiens glandulifera*) (Fig. 2). These practical conservation

Fig. 2. Wetland area, Fernbrae Meadows LNR, as seen from the boardwalk. (Photo: N. Digruber)

actions are done in an effort to aid natural regeneration of native species, control the spread of invasive species and reduce erosion alongside water courses. A new butterfly transect route has been established with the help of the countryside rangers and the charity Butterfly Conservation. Training has been delivered to local people to enable them to monitor and record the species of butterflies found on the site (Fig. 3).

Fig. 3. Small tortoiseshell (*Aglais urticae*), Fernbrae Meadows LNR. (Photo: N. Digruber)

The Friends group has also worked with other conservation charities, such as Amphibian and Reptile Conservation and the British Dragonfly Society, to enhance the habitat for these species and to provide educational pond-dipping sessions and stream surveys. There is also a focus on nature-friendly gardening with talks for members and allotment holders about gardening for wildlife. Dragonflies (Fig. 4) are also being recorded on an annual basis and several badger surveys have been undertaken with the help of the charity Scottish Badgers. Other regular activities include litter picking, path repair works, general maintenance and social outings. The countryside rangers have also started lunchtime "hero" sessions to encourage more people from the local community to come to Fernbrae Meadows and help with various volunteering tasks (Fig. 5).

Fig. 4. Common darter (*Sympetrum striulatum*) resting on the new boardwalk, Fernbrae Meadows LNR. (Photo: N. Digruber)

Fig. 5. Community pond dip event with Amphibian and Reptile Conservation, Fernbrae Meadows LNR. (Photo: N. Digruber)

The stream flowing through the Meadows was straightened and channelled during golf-course landscaping. During works in 2018, stream banks were re-widened and, in places, a meandering flow was allowed. Additionally, a wetland area was created and, to deal with flooding issues, two Sustainable Urban Drainage System Ponds (SUDS) were formed. A small stream was re-routed to create a wetland area on the eastern side of the LNR. As this burn passes through agricultural land before entering the LNR, its water quality has also been monitored. A recent investigation

has revealed nitrate pollution and low scores for macro-invertebrate assemblages based on the Biological Monitoring Working Party (BMWP) scores (Hawkes, 1998) at four sampling points along the stream. Continued monitoring of water quality, dragonflies, water beetles and other invertebrates is intended. This will provide data to assess if water pollution continues to be an issue and to record the colonisation of aquatic species in the newly developed freshwater habitats (Fig. 6).

Following on from the major landscaping in 2018, the Friends group secured funding to create a wildflower meadow at the eastern side of the site, close to the SUDS ponds. The mixture of native Scottish wildflowers, including yellow rattle (*Rhinanthus minor*), has greatly enhanced the habitat for pollinators (Fig. 7). In 2021 we supported the countryside rangers in establishing a butterfly transect to monitor their numbers on a yearly basis. Depending on volunteer numbers, we would also like to help monitor bees in the future. Yearly maintenance of the wildflower meadow has been coordinated with the countryside rangers, who also arranged "meadow-maker" events, where volunteers collected wildflower seeds for new plantings. Further expansions of wildflower habitats are planned for 2022.

The Friends group has been a great asset for Fernbrae Meadows, and has been working hard towards their constituted aims. The group has established great links with conservation charities as well as other local community groups and is part of Greening Camglen, a network of local groups that work towards a greener and more sustainable future. Continued litter picks and contact with the wider community via social media and in person is helping to make Fernbrae Meadows a welcoming place for everyone. A weekly health walk has been run by volunteers for the last few years and continues to be popular. A community garden has been established with the help of Greening Camglen. The Friends have also facilitated many events and activities over the years that support both nature and people.

Fig. 7. Yellow rattle (*Rhinanthus minor*) sown by the community as part of the wildflower meadow, Fernbrae Meadows LNR. (Photo: N. Digruber)

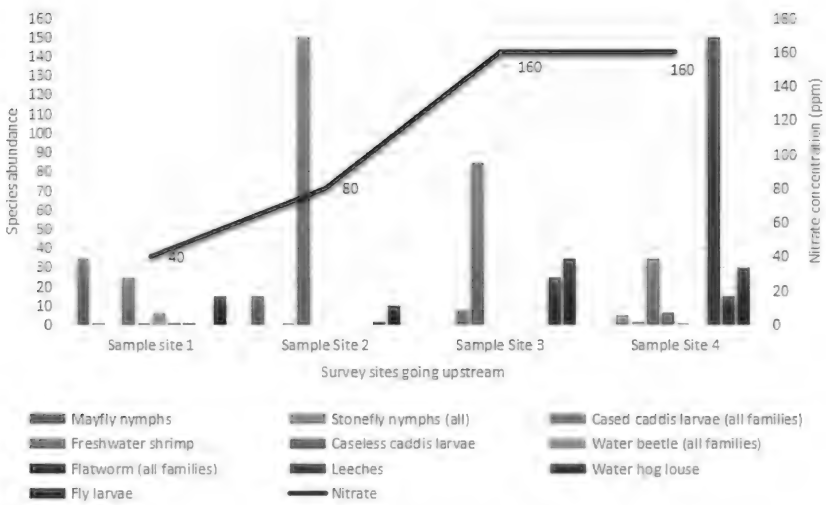

Fig. 6. Water quality survey results at Fernbrae Meadows LNR. Species abundance and nitrate measurements across four kick sample sites going upstream towards farmland.

Future plans include further surveying and recording of the site's biodiversity, maintenance of the wildflower meadow habitats, the creation of new wildflower areas, monitoring of the water quality, training for local volunteers, and research into the historic aspects of the site. The continued community engagement is an important aspect, as the group wishes to connect more local people with nature. Several natural craft sessions have been arranged and the group continues to work alongside the countryside rangers to support the management plan of the site. A celebration of the LNR designation is planned for the summer 2023.

I would like to acknowledge the contributions to the Fernbrae Meadows LNR project made by various organisations and individuals, including Friends of Fernbrae Meadows (Clare Thompson, Alison Park, Andy Wilson, Margaret MacRobert, David Collings, Councillor Margaret Cowie and Councillor Robert Brown), Community Links Blantyre, South Lanarkshire Countryside Rangers, Greening Camglen, Healthy n Happy Community Trust, Glasgow Natural History Society, Garth Foster, Andrea Hudspeth, Anthony McCluskey and Janet Ullman.

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Brownfield Conference visits to Hamiltonhill Claypits and Malls Mire, Glasgow, Scotland

R.B. Weddle[1] & J.R. Downie[2]

[1]89 Novar Drive, Glasgow G12 9SS
[2]School of Biodiversity, One Health & Veterinary Medicine, Graham Kerr Building, University of Glasgow, Glasgow G12 8QQ

[1]E-mail: richard@canto.plus.com

During the planning stages of the Brownfield Conference, it was agreed that a useful addition to the programme would be a couple of excursions on the day after the conference, to locations covered in the talks programme. This idea was enthusiastically accepted by Glasgow Science Festival, with booking being arranged separately from the conference. The relevant speakers very generously agreed to lead the excursions. Accordingly, on Sunday June 5th 2022, a beautiful sunny day as it turned out, groups of 20-25 people visited two of the local brownfield sites which had featured in the conference the day before. The groups included people who had attended the conference in person or online, and others who had only heard about the visits.

HAMILTONHILL CLAYPITS (NS674676)

The excursion was co-led by Martin Faulkner, a speaker from the Brownfield Conference, and Jill Malvenan of Scottish Canals who had managed the recently completed project to enhance the canal banks, install paths, and install the Sustainable Drainage Systems (SuDS) works. We heard how the latter, in conjunction with the canal network, contributes to flood prevention in central Scotland generally, and we were shown the new "Garscube link" consisting of a new footbridge over the canal, together with a zig-zag footpath (and a slide) down the steep slope to Garscube Road, almost opposite Woodside Health Centre. This in turn reminded us of the positive effects of greenspaces on mental health and well-being.

A swale running downhill from the site of the former primary school on Ellesmere Street to the new pond should eventually provide a habitat that was lost when a "greywater" drainage pipe was installed along the course of a ditch alongside the southern access path, though neither pond nor swale is expected to reach full potential until proposed new housing is built to the east of Ellesmere Street.

We were interested to have an unusual fungus *Monilinia johnsonii* (hawthorn leaf-blight, or haw-cup) pointed out by Emily Williams, one of the speakers at the conference the previous day. This was the first record in the Glasgow area, but is very likely to be under-recorded (Fig. 1). We also noted nettle rust-fungus (*Puccinia urticata)*, azure damselfly (*Coenagrion puella),* common carpet moth (*Epirrhoe alternata*), and the less welcome harlequin ladybird (*Harmonia axyridis).*

Fig. 1. Hawthorn (*Crataegus monogyna*) with leaf-blight fungus (*Monilinia johnsonii*) at Malls Mire, Glasgow, Scotland. (Photo: David Palmar)

MALLS MIRE (NS602621)

The group was again led by the speaker from the Brownfield Conference, Gemma Jennings. We started out in the area currently designated as a local nature reserve (LNR), which is mainly mixed woodland, though there is still a central wetland area and several ponds testifying to its history as "mire". Much of the path network has been surfaced in recent years, and a boardwalk installed at the wetland. Gemma showed us some woodland clearings furnished with logs to sit on which are used for outdoor education (Fig. 2).

Fig. 2. GNHS members with Gemma Jennings at Malls Mire, Glasgow. (Photo: David Palmar)

We then moved to the area around several SuDS ponds, which also includes a well-tended community allotment area. This area is proposed as part of an extension to the LNR. Here I showed the group samples of the leaf-beetle *Bruchidius villosus* found on broom beside one of the ponds. This is a species that I have been finding recently in the Greater Glasgow Area, though it is apparently unrecorded elsewhere in Scotland. Emily Williams again found *M. johnsonii* on hawthorn bushes. We were pleased to spot a roe deer amongst the shrubbery by the pond nearest the waste-disposal site, and we also noted the flame moth (*Axylia putris*), cocoons and caterpillar of the six-spot burnet moth (*Zygaena filipendulae*) (Figs. 3 and 4), an early bumblebee (*Bombus pratensis*), many small heath butterflies (*Coenonympha pamphilus*), a green lacewing (*Chrysopidae* sp.) and several blue damselflies, some mating at the ponds.

CONCLUSION

All those attending the excursions agreed on the value of visiting the sites in person, and that it was fascinating to see how well these previously derelict sites were responding to management designed to enhance biodiversity and how they were also providing good quality greenspace access to local people. The conference organisers thank the guides for giving up their time, and look forward to hearing more about the development of these sites.

Fig. 3. Six-spot burnet moth (*Zygaena filipendulae*) cocoon at Malls Mire, Glasgow. (Photo: David Palmar)

Fig. 4. Six-spot burnet moth (*Z. filipendulae*) caterpillar at Malls Mire, Glasgow. (Photo: David Palmar).

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Open mosaic habitats on brownfield sites

S. Burgess

Buglife, Unit 4, Beta Centre, Stirling University Innovation Park, Stirling FK9 4NF

E-mail: suzanne.burgess@buglife.org.uk

INTRODUCTION

Brownfields are sites that have been altered by human activity and are currently not in full use. They tend to be concentrated in urban and former industrial landscapes, but also include quarries, old railway lines and the spoil heaps from coal mines (known as bings in Scotland). It is the lack of management on derelict brownfield land that creates an Open Mosaic of Habitats on Previously Developed Land (OMHPDL). Sites with OMHPDL typically support areas of species-rich grassland, bare ground, scrub and early successional habitats (Fig. 1). OMHPDL is a priority habitat and is on the Scottish Biodiversity List (NatureScot, 2022).

WHY IS OMHPDL IMPORTANT TO WILDLIFE?

The diverse habitats at brownfield sites with OMHPDL are home to a wide range of plant and animal species, allowing many to complete their life-cycles at the same site, as a continuity of resources is provided throughout a season. Many OMHPDL features of brownfields can no longer be found in highly managed greenspace. Between 12% to 15% of nationally rare and scarce insects have been recorded from Britain's brownfields (Gibson, 1998). OMHPDL on brownfield sites is an important component of green networks, acting as stepping-stones for wildlife to move from one area to another.

At least five criteria need to be met for a brownfield site to qualify as OMHPDL (Riding *et al.*, 2010):

1. The area of open mosaic habitats is at least 0.25 ha in size.
2. There must be a known history of disturbance at the site or evidence that soil has been removed or severely modified by the previous use(s) of the site. Extraneous materials/ substrates such as industrial spoil may have been added.
3. The site contains some vegetation that will comprise early successional communities consisting mainly of stress-tolerant species (e.g. indicative of low nutrient status or drought). Early successional communities are composed of a) annuals or b) mosses/liverworts or c) lichens or d) ruderals or e) inundation species or f) open grassland or g) flower-rich grassland or h) heathland.
4. The site contains unvegetated, loose, bare substrate and pools of water may be present.
5. The site shows spatial variation, forming a mosaic of one or more of the early successional communities a)–h) above (criterion 3) plus bare substrate, within 0.25 ha.

A simple flowchart was designed by Macadam *et al.* (2013) using these five criteria. This flowchart allows for a rapid assessment to identify if a site supports OMHPDL and whether further surveys are required (Fig. 2).

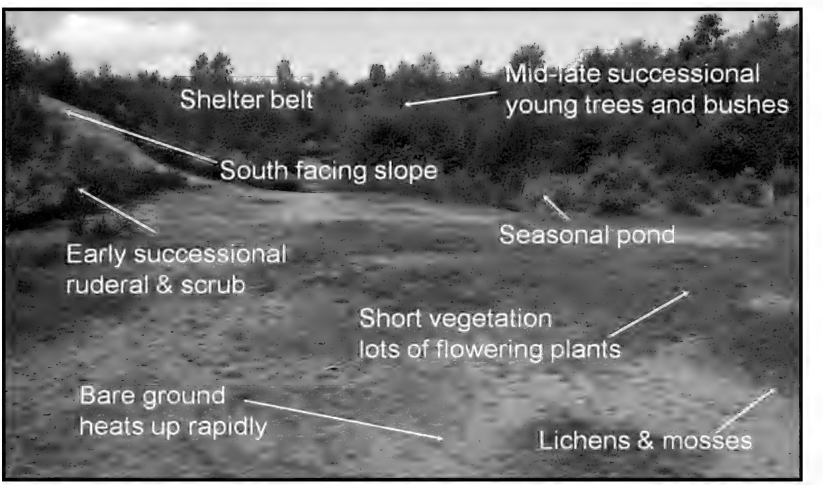

Fig. 1. Examples of microhabitats that can be found at a brownfield site with OMHPDL.

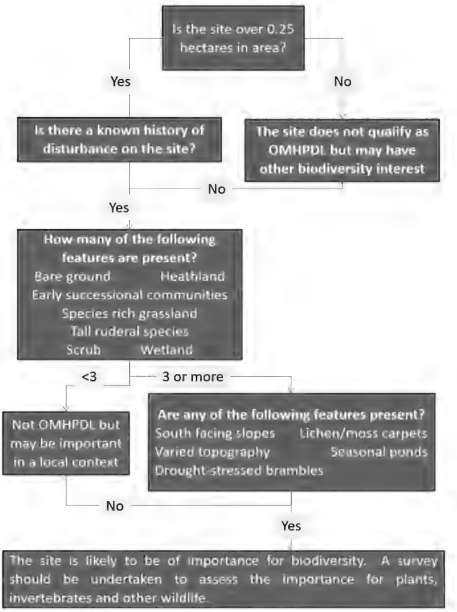

Fig. 2. Flowchart used to rapidly assess a brownfield site and identify if it supports OMHPDL, and whether further surveys are required (from Macadam *et al.*, 2013).

OMHPDL AND PLANNING

Brownfields are often regularly used by the public for recreation, and some are extremely attractive places to visit. In many built-up areas, brownfield sites may be the sole semi-natural green space that people encounter. If properly managed, they could help to significantly reduce the number of areas lacking accessible open space and contribute to the delivery of urban green networks.

In Scotland, National Planning Framework (NPF) 3 aims to bring brownfield sites back into productive use for housing, for economic purposes, and to create attractive environments. Following on from the NPF 2, the NPF 3 also aims to implement the Scottish Biodiversity Strategy, including completing the suite of protected places and improving their connectivity through a national ecological network centred on these sites.

Using mapping technology within development planning, it should be possible to retain OMHPDL features in green networks whilst encouraging the redevelopment of brownfield sites that are less important for biodiversity.

Capitalising on OMHPDL:

1. Brownfields are transitory in nature (due to the natural process of succession) and have a typical lifespan of 15 to 20 years (Kattwinkel *et al.*, 2011): they can be used for short to medium term gain.
2. Only where the OMHPDL is of regional importance as part of a green network for biodiversity and/or recreation should consideration be given to longer term retention as part of the Nature Networks.
3. It is important to ensure that there is a network of interconnected OMHPDL "stepping-stones" at varying stages of succession.
4. When redeveloping sites which support OMHPDL, consideration should be given to the retention of features of OMHPDL within the grounds of the new development. Examples of mitigation include green roofs, flower-rich meadows and insect/bee banks.

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The impact of urbanisation on body condition and size in *Bombus hypnorum* and *Bombus lucorum* agg. (Hymenoptera: Apidae) in urban (parkland and brownfield) and rural sites in the west of Scotland

E. Plant

Geographical and Earth Sciences, University of Glasgow, Glasgow G12 8QQ

E-mail: e.plant.1@research.gla.ac.uk

Urbanisation is increasing globally, resulting in the conversion of natural land to land characterised by

impervious urban surfaces (Łopucki & Kitowski, 2017). Urban environmental variables are thought to influence bumblebee physiological traits, which could confer a loss of fitness (Ayers & Rehan, 2021). Numerous studies have investigated the impact of urbanisation on body size, yielding mixed results (Banaszak-Cibicka *et al*., 2018; Eggenberger *et al*., 2019; Theodorou *et al*., 2020). However, body condition is an important metric for both individual and environmental health, which has been understudied in the urban context.

Here I describe a study that compared two bumblebee species from 12 urban sites, nine parks and three brownfield sites in Glasgow, Scotland (hereafter collectively called "urban" sites), and 12 rural sites, around Loch Lomond, about 20 miles to the north of the city. This study revealed that urbanisation had no negative effect on body condition. Urban and rural populations of the two species tested in this study, *Bombus lucorum* agg. and *B. hypnorum*, showed no significant loss of body mass, as indicated by log likelihood tests comparing models with or without urbanisation as a factor (*B. lucorum*: $2\Delta LL = -2.1$, DF = 1, $p>0.05$; *B. hypnorum*: $2\Delta LL = -2.75$, DF = 1, $p>0.05$). Furthermore, in both species, the body size of urban specimens did not differ significantly from that of specimens from rural environments (*B. lucorum*: $2\Delta LL = -2.7$, DF = 1, $p>0.05$; *B. hypnorum*: $2\Delta LL = -2.78$, DF = 1, $p>0.05$), suggesting there was no loss of fitness in the urban populations of the species measured.

The influence of environmental variables measured (temperature, green space area, habitat fragmentation and flower abundance) were not always as expected. There was no evidence of the urban heat island effect in Glasgow, with no significant difference in temperature variation found between the urban and the rural sites. Floral abundance did not appear to differ between urban and rural sites either. The influence of these environmental variables on bee body size and condition were also unexpected. For example, intertegular distance in *B. lucorum* agg. increased as fragmentation decreased, when the study by Theodorou *et al*. (2020) predicted that larger body sizes would grant a mobility advantage in fragmented landscapes. This led to the conclusion that local and landscape variables have a complex relationship with bumblebee size and condition, and can in turn influence each other.

Although this study reveals positive findings for the influence of urbanisation on bumblebees, it is imperative that the management of urban green spaces ensures that an ample number of floral resources is provided, in order to help bumblebees thrive. The full results of this study are being prepared for publication elsewhere.

I would like to thank Jeanne Robinson for her support, supervision and valuable feedback throughout this project.

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Book Reviews

Field Guide to Coastal Wild Flowers of Britain, Ireland and Northwestern Europe

Paul Sterry & Andrew Cleave
Wild Nature Press, 2022. 352 pages, paperback with numerous colour photographs and distribution maps.
ISBN 9780691218151.
£19.99

I was given this book some time before writing the review and was thus able to read and use it over the summer months. My first impression when opening the book was that the quality of the photography is superb. Most of the photographs have been taken by the authors and it did not surprise me to read that Paul Sterry is well known as a photographer as well as a wildlife author. There are over 1,500 excellent colour photographs of coastal habitats and individual plant species. Also included are a glossary and illustrations to help with identification.

The introductory chapters cover detailed descriptions of the range of different coastal habitats, sandy and green beaches, shingle, machair, estuaries and saltmarshes, heaths and cliffs. Each habitat also has illustrations of key non-plant species with interesting and detailed information alongside superb photographs.

The main body of the text covers over 600 species of flowering plant and an additional selection of ferns, bryophytes, fungi, lichens and seaweeds. The description for each species follows a similar pattern which has been adopted throughout. Each species has at least two photographs, typically of the whole flowering plant together with a close-up of the flower or leaves, illustrating the most relevant diagnostic features. Each has a common name and a Latin name. Each has details of height, ecology and natural history, habitat, flowers, fruits and leaves plus a small map of British and Irish status and an indication of its northwestern European status. Where necessary, fuller and more detailed descriptions are provided to allow differentiation between closely related or easily confused species. The whole approach is beautifully laid out and very readable; it would make the identification or revision of some tricky groups such as the oraches (*Atriplex*) and grasses easier and (almost) fun because of the quality of the illustrations.

All this is very positive. My own background is botanical and I could certainly learn from this book. However, this is not a complete flora. Whilst using this book, I quickly picked up some omissions such as orpine (*Sedum telephium*) and meadow saxifrage (*Saxifraga granulata*) both of which occur on the Ayrshire coast. Some of this can be put down to the distribution maps being rather small, but there are also textual inaccuracies and grammatical confusions. For example, the bee orchid *(Ophrys apifera*) which occurs in Ayrshire and elsewhere in coastal sites in southwestern Scotland is "locally common only in England, Wales and S. Ireland". This may suggest a lack of up-to-date information. The authors do cover issues of this sort in their "About this Book" paragraphs. Primarily, this book is a "celebration of coastal flowers" which aims to help the casual visitor to identify flowers and appreciate their environment, and to hone the skills of seasoned botanists and encourage recording. The authors do refer readers to Clive Stace's *New Flora of the British Isles* and the website of the Botanical Society of Britain and Ireland. This pretty well covers any criticism I have, and one has to recognise that much up-to-date information is available only digitally these days.

Would I recommend this book? Yes, I think I would. Some of its limitations annoyed me at first, but the authors have clearly covered these in their introduction. I do think this book would be an excellent and informative introduction for a visitor to the coast and, above all else, the illustrations are of exceptional quality, making it a joy to pick up and read. Particularly welcome is a "Quick index to iconic species and groups" inside the flap of the outer cover. This would help put the inexperienced reader in the right direction for identifying an unknown species.

Alison Moss

The Peatlands of Britain and Ireland - A Traveller's Guide

Clifton Bain
Sandstone Press, Muir of Ord, 2021. 256 pages, hardback illustrated with photographs and drawings.
ISBN 9781912240241.
£24.99

Like many people, I have been aware of bogs from childhood, through warnings of disappearing into Dartmoor's mire or history lessons about East Anglian fens. As an adult I realised that there is more to these areas than watching one's step. Some years ago a ranger-led excursion across Flanders Moss, Stirlingshire opened my eyes to the variety of mosses and other plants, insects and other animals that live in this habitat, as well as its human history. More recently the importance of peatlands in the fight to halt climate change has been publicised widely. So it was with pleasure I accepted the invitation to review this timely book.

In June 2022, Clifton Bain's expertise in this area and his work for the International Union for Conservation of Nature's Peatland Programme was recognised by the award of an Honorary Fellowship from the Royal Scottish Geographical Society. This book is the final part of his trilogy, the previous parts of which explore the ancient pinewoods of Scotland and the Atlantic rainforests of Britain and Ireland. With all that in mind,

I approached his book with eager anticipation.

This "traveller's guide" is a splendidly presented volume. The well-spaced, easy to read text is accompanied by superb photographs, maps and paintings. It is not a book you will slip into your backpack to consult while standing in the rain on a damp boardwalk peering across waving cotton grass into the misty distance. Rather, it will form part of your preparation for visiting these beautiful and important places. It is a book to enjoy while planning your trips.

After a Foreword by Dr Tony Juniper and the Acknowledgements, Clifton Bain has divided the book into two clear sections. The shorter Introduction supplies general information about peatlands across the country, covering different aspects of interest: formation, wildlife, archaeology, the use of peatlands over the centuries, varying language used across the countries considered, and the current drive to restore and conserve. The second, and larger, part of the book describes individually the peatlands the author has selected. He admits the choice of places is personal, but explains the criteria which have guided his selection. This part is divided by country, Scotland, England, Wales and Ireland (Northern and the Republic), before being subdivided into region, each with named sites. It is clear and unambiguous, making finding information about a specific place very easy.

The description of each peatland follows a common format. At the start, along with the Ordnance Survey (OS) reference, there is a map highlighting the moss, showing access point(s), trails and specific places of interest. There follows a summary of the area's history, with mention of particular activity which might have affected the state of the bog today. In many places Bain gives credit to local interest groups who have become involved in restoration work. For example, fires caused by vandalism used to be a problem at Blawhorn Moss, one of the Clyde-Forth Mosses. However, with the involvement of the community of Blackridge village, access routes have been developed and a local blacksmith has installed bog-inspired artworks. The area now supports breeding red grouse (*Lagopus lagopus scotica*), curlews (*Numenius arquata*), and snipe (*Gallinago gallinago*) with hen harriers (*Circus cyaneus*) and short-eared owls (*Asio flammeus*) being seen in winter.

The cutting of peats, both domestically and industrially, together with drainage for agriculture, has damaged many peatlands throughout Britain and Ireland. Such damage is still visible in many places, and excellent photographs show this along with results of restoration work. On page 163 an aerial photograph of Fenn's Moss, part of the Midland Meres and Mosses complex, shows clearly how bunded cells are used to retain water levels. "Cell-bunding… a technique… in which impermeable low peat 'bunds' are used to create a network of water-holding cells… These cells ensure that rainwater is retained on-site long enough for the 'acrotelm' to re-form, and the site to once again start growing peat." For those unfamiliar with the term, acrotelm is the upper layer of a peat bog, in which organic matter decomposes aerobically.

One of the starkest reminders of how damaging 19th century drainage was is shown by two cast-iron posts among the trees of Holme Fen, part of the Cambridgeshire Fens. "In 1848, when plans were being made to drain Whittlesey Mere, local landowners were concerned about the surrounding peat drying out, shrinking and lowering, with the risk of flooding and possible inundation from the sea. A long post was driven down through seven metres of peat to the clay substrate, with its top cap at ground level to allow any changes in peat depth to be monitored. In just over 170 years the ground has dropped to leave an incredible four metres of post now visible." This area is now supposedly the lowest point of land in Britain at around 2.7 m below sea level. Bain continues to explain the challenges of conserving such an area, where the wetland is above shrinking farmland. In other parts of the great fenland, once a huge peatland landscape, restoration is more successful - for example at Wicken Fen and Woodwalton Fen, both Cambridgeshire, one of Britain's oldest nature reserves dating from the early 20th century.

Evidence from Dartmoor reveals that these areas have "preserved a wealth of archaeological information, demonstrating the area's importance for humans over the last 10,000 years, with abundant prehistoric settlements, burial tombs, monuments and ritual sites." The Neolithic and early Bronze Age clearance of forests in this area was abandoned as the climate became wetter, which contributed to the subsequent formation of peat. Similarly, in Cors Fochno (Borth Bog in North Wales) there is an amazing "'sunken forest'… ancient tree stumps revealed in the sand at low tide and in extreme weather. These are the preserved remains of a forest of pine, alder, oak and birch that grew here around 5,000 years ago, before the peatland formed, and which was then eroded by the estuary waters."

Dartmoor is not alone in providing us with ancient remains. For example, in many areas wooden trackways have been discovered, of Bronze Age origin or earlier. There is a photograph of an Iron Age trackway at Corlea, County Longford. Perhaps most famous are the numerous bodies, or body parts, that have been found in bogs throughout Britain and North-West Europe. At Lindow Moss in Cheshire, one such very well-preserved part of a skull had skin tissue and hair attached, which proved to be almost 2,000 years old, from a male living in Roman Britain.

Much of the natural history is replicated on different sites, but certain places provide a home for more unusual creatures. How could anyone interested in bugs not be encouraged to visit Thorne and Hatfield Moors, South Yorkshire, which "boast the highest variety of insect species of any peatland in the UK and are home to species found nowhere else in the country…" and where the female "bog hog" beetle (*Curimopsis nigrita*) lines

her burrow in the peat with sheets of moss. The same area "is abundant with crane [*Grus grus*], bittern [*Botaurus stellaris*] and marsh harrier [*Circus aeruginosus*]". Well worth a visit! At Cors Caron, near Tregaron, Ceredigion, Wales, you might be fortunate enough to see the rosy marsh moth, "thought to have become extinct in Britain over a hundred years ago but discovered here in recent years." Or if you are in Shropshire, you might be tempted to visit the Marches Mosses, where recovery work has led to the first breeding snipe "returning to Whixall Moss in 2019 after an absence of over twenty years". This is important because there are only ten breeding pairs of snipe in the whole of Shropshire. Here you might also spot a "seven-centimetres wide raft spider [*Dolomedes fimbriatus*]… standing on open water among the sphagnum carpets," or the rare white-faced darter (*Leucorrhinia dubia*) which is one of 29 species of damselflies and dragonflies found here.

Some peatlands support particularly interesting plants. Rannoch Moor, north-west central Scotland, is the "best remaining peatland site in Britain to find the rare Rannoch-rush (*Scheuchzeria palustris*)" while in Ireland's Diamond Hills area the rare heather "Saint Dabeoc's heath (*Daboecia cantabrica*) is found only in Connemara, South Mayo and parts of the Atlantic fringe of South-West Europe."

The Peatlands of Britain and Ireland is a treasure trove of information about these fascinating landscapes. But its title claims it is "A Traveller's Guide". So, how well does it take us to these marvellous places? At the end of the Introduction, Clifton Bain gives some general advice about visiting peatlands: how best to appreciate them; advantages of different times of year; respect for the wildlife; becoming involved with restoration work; taking account of other cultural points of interest in the surrounding area; and perhaps, most importantly, how to protect against the biting flies who inhabit such places!

I have put the instructions to the test. The maps are clear. The Travel Notes vary in the amount of detail given but tend to focus on trains, buses and bicycles with little guidance for car drivers, though a site's map can be used in conjunction with a road atlas or the relevant OS sheet. Where a group of peatlands is being described (e.g. Clyde-Forth Mosses) there are more detailed directions for the car driver from moss to moss. Travel notes for The Peak District Moors give a detailed description of part of the Pennine Way from Edale to Marsden, though detailed information on this well-trodden walking route is widely available elsewhere.

My main criticisms concern the reference to websites and the lack of an index. With a view to visiting a couple of sites unknown to me, I used this book as a start and then turned to the internet to research further - partly to check the book's information, and partly to expand it. I was surprised that no relevant website links were provided in the same place as the other site-specific information. The list of "Useful Websites" is at the back of the book. Some of these apply to more than one peatland (e.g. Natural England, NatureScot, National Trust for Ireland etc.), while others are particular (e.g. Connemara National Park, Marches Mosses BogLIFE, Solway Wetlands etc.). I think it would be more helpful to have websites listed with the relevant site, particularly as websites should provide the most up-to-date information, while the book is accurate only at the date of writing.

There is a good Contents page at the start together with a map of Britain and Ireland showing the locations of the selected peatlands. However, there is no index. Thus, when wanting to find out where "bog bodies" had been discovered, I had to look through the whole text. Also, several peatlands mentioned in the general Introduction are not featured as selected areas. If I wanted to see if a particular place was included in the book, other than as a selected peatland, I had no way of doing so, other than to read the whole Introduction.

My overall opinion is that this book is both useful and beautifully presented. I would use it as a good starting point to discover these important areas and would recommend it to others. It is a book which inspires exploration.

Anne Orchardson

Wild Mull: A Natural History of the Island and its People

Stephen Littlewood & Martin Jones
Pelagic Publishing, 2021. 300 pages, paperback with colour photographs and illustrations. ISBN 9781784272760.
£25.00

Wild Mull is a versatile guide combining a visual journey told through Martin Jones' photographs with comprehensive writing by expert naturalist Stephen Littlewood. It is an un-intimidating read, its text enhanced regularly with large, attractive colour photographs displaying the island's unique beauty through the lens of an award-winning photographer. This book will appeal to any lover of the islands off Scotland's west coast; it guides the reader unassumingly through all facets of Mull's wilderness and successfully captures the enchanting way of Inner Hebridean life. The 12 chapters (each crowned with a short verse of Hebridean poetry or apt quotation) deal with specific aspects of Mull's unique anthropology or environment. These include chapters on the geology of Mull, how humans have shaped the island, fungi and lichens of the celtic rainforest, insects, small vertebrates, marine life and the introductions and extinctions that have accompanied the human footprint; there are three chapters on birds – seabirds, landbirds, and the raptors for which the island is so famous. The text is accessible both to those with an amateur interest in the nature of the island, as well as to the experienced naturalist.

Littlewood demonstrates an intimate understanding of Mull as an island and the true value of the interconnectedness between people and nature resonates strongly. The book celebrates Mull as a well-known raptor site with a healthy population of both golden

eagles (*Aquila chrysaetos*) and white-tailed sea eagles (*Haliaeetus albicilla*), and as a known playground for the Eurasian otter (*Lutra lutra*). However, the true beauty lies in the celebration of themes less well-known to the passing visitor. The island is a stronghold for ever-diminishing temperate rainforest. On Mull, the "celtic rainforest" supports a plethora of unusual lichens, as well as being home to the extremely rare hazel-gloves fungus. Indeed, Mull is of international fungal importance, boasting over 2,000 species.

I particularly admired the postscript, where Littlewood removes any rose-tinted spectacles regarding the many invasive and non-endemic anomalies that inevitably establish themselves on long-inhabited islands. The author discusses each angle pragmatically, but manages to leave the reader with a sense of optimism for how resilient and adaptive both islanders and wildlife can be.

The inclusion of some maps would be useful for those who do not know the island intimately on the ground, but this is an isolated flaw. *Wild Mull* has all the ingredients of a truly enjoyable read. It is a beautiful depiction of place and a reference guide that does justice to a unique island that fully deserves such masterful coverage.

Laura C. Thubron

Edible Fungi of Britain and Northern Europe: How to Identify, Collect and Prepare

Jens H. Petersen
Princeton University Press, 2023. 154 pages, hardback with many colour photographs and black-and-white illustrations. ISBN 9780691245195.
£17.99

As someone who has a long-term interest in fungi, particularly edible chanterelles (*Cantharellus cibarius*) and ceps (*Boletus edulis*), I was excited to be asked to review this book. Fungi and mushrooms are fascinating and varied organisms with hundreds of species found in Scotland and Britain, and thousands throughout the world. Many of these are inedible, with some mildly poisonous, a few deadly poisonous, and some wonderfully edible with a few of the latter being gastronomic delights. The challenge has always been to safely identify the edible varieties and not confuse them with poisonous look-a-likes.

Hence, the publication of *Edible Fungi of Britain and Northern Europe*, which specifically sets out to do this, is useful and important. The book is nicely produced with many excellent colour photographs. It contains a comprehensive introduction, explaining what fungi are, habitats where they are found, how to collect and cook fungi, and legal aspects of collection.

The central sections of the book describe and illustrate the main types of edible fungi, including morels, boletes, chanterelles, brittlegills, milkcaps, agarics and puffballs. In each case, much detail is given to explain how to identify the edible species with particular care taken to show similar poisonous look-a-likes, with many excellent photographs and keys to allow this to be done.

However, despite the care that the author has taken in creating this book I still ask the question: "Is it successful in providing enough information to give novices to fungi-collecting the confidence to identify edible species with certainty, and therefore safely?" I personally am not convinced that, by itself, *Edible Fungi of Britain and Northern Europe* accomplishes this function. Being a cautious mushroom collector, I restrict myself to a few species with which I am familiar. I only acquired confidence to identify these species by participating in "fungi forays" accompanied by experienced mushroom pickers who, in the field, were able to show me directly what the edible species looked like, and the type of habitat and time of year that they were found. This direct and personal instruction was essential. With this acquired knowledge and experience I still only restrict myself to chanterelles and a few bolete species. Anything I am not 100% sure about I do not harvest. Perhaps I am over cautious, but this has meant I have never had any trouble (touch wood!).

To conclude, I liked *Edible Fungi of Britain and Northern Europe* very much and I hope that this book introduces the world of edible fungi to many new people. For this purpose, I would encourage those interested to buy it. But I would urge that the book be used only as a supplement to direct contact with edible mushrooms when folk attend an organised fungi foray and are shown the species by knowledgeable and experienced "mushroomers". Only then will they be genuinely confident about what they are collecting. This will then allow people feel secure to enjoy the fantastic taste of these fungi.

Christopher J. McInerny

How Birds Live Together: Colonies and Communities in the Avian World

Marianne Taylor
Princeton University Press, 2022. 224 pages, hardback with many colour photographs, maps and other illustrations. ISBN 9780691231907.
£25.00

Some years ago, we stayed on Bird Island, one of the northern, coralline islands of the Seychelles group. Its name derives from some three quarters of a million nesting pairs of sooty terns (*Sterna fuscata*) which are the star attraction. The colony was surrounded by "police incident" tape. If the nest was inside the tape, it was sacrosanct but, if it was outside, the eggs could be taken by the hotel restaurant to make omelettes - a stark, if wholly anthropogenic, illustration that it is safer to be at the centre of a bird colony than at the periphery.

Bird Island is one of several "colony profiles" in this beautifully illustrated book. Other sea-bird strongholds featured include the Bass Rock, Troup Head, both Scotland and Grassholm, Wales, while non-maritime examples include Matera, Italy for lesser kestrels (*Falco naumanni*) and the Cota Doñana, Spain (egrets, ibises and herons). The book divides into ten short chapters

many of which are based on habitat. Thus, there are chapters on colonies on sea cliffs, in trees, on beaches and islands, in lakes and marshes, in burrows and in towns. There are also chapters which explore the co-existence of several species (sometimes including prey and predator) and how birds decide whether to join or leave a colony. Most bird colonies are highly conspicuous, but one chapter discusses "secret colonies" such as those of cave-nesters. There is not much on birds living together outside the breeding phase, such as in feeding assemblages and mass migration movements.

The "how" in the title *How Birds Live Together* is appropriate, because this is a book based largely on specific examples and each chapter ends with one or more representative species discussed at length. Despite this, there are no references, and in a book of this nature there really should be. If the work of scientists is worth writing about in detail, then the scientists themselves deserve a mention and the reader deserves a reference to follow the topic up. As an example, pages 138-139 show graphs of how heron and ibis numbers have fluctuated dramatically in the Cota Doñana over a 12-year period. But who has collated and published these painstaking and methodical data?

As to "Why birds live together", authors such as Brown & Brown (2001) and Danchin & Wagner (1997) set out the three major benefits: a) vigilance and defence against predators; b) food-finding by observation and/or co-operative hunting; and c) safe and suitable nesting sites may be limited in number. All of these get mentions at appropriate places in the book, even if it is difficult to pin down the dominant factor in any specific case. There is less discussion of the downsides to colonial living, which include the spread of parasites and disease, the fact that colonies advertise themselves to predators, and that they may place a burden on local food resources. Close proximity also facilitates extra-marital affairs and parasitic egg-laying, so that parental energies can be mis-directed towards furthering someone else's genes.

Although this book is perhaps stronger on individual examples than on synthesis or theory, those examples are interesting and diverse, covering all the continents and a wide variety of bird species. Like all Princeton University Press books, it is illustrated with dozens of beautiful coloured photographs as well as appropriate maps and other illustrations.

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Tony Payne

Much Ado about Mothing. A Year Intoxicated by Britain's Rare and Remarkable Moths

James Lowen

Bloomsbury Wildlife Press, 2021. 384 pages, hardback with colour photographs. ISBN 9781472966971. £18.99

The author may be intoxicated, but this book has gained many devotees amongst otherwise quite sober naturalists. It was recommended to me by several GNHS members and has already gone into a paperback edition. It belongs to the popular genre of "quest" books (to see all British orchids in a year; to bag all the Munros; to run a marathon on every continent) but it is a rather looser affair. The author has indeed set himself a time limit – one year – but he criss-crosses Britain with the simple intent of bringing the reader a series of vivid encounters with moths and moth-ers.

His conversion from an initial view that moths are small, brown, uninteresting and best avoided is partly due to an encounter with a poplar hawkmoth (*Laothoe populi*) and partly to discovering that his young daughter is just as enthusiastic as himself. Together they trap moths, first in London and then, after a move to a bungalow with a large garden, in Norwich. Interestingly, London was more productive.

Lowen sometimes makes heroic journeys with a couple of friends to find a regional speciality, at which point the book can resemble *Top Gear* for lepidopterists. His journey up the A9 to find the Rannoch brindled beauty (*Lycia lapponaria*) and Kentish glory (*Endromis versicolora*) is typical: the early Scottish spring has advanced flight times by a fortnight, causing panic and domestic chaos in all their households. He describes the wingless female brindled beauty as a sultana which has gathered fluff, but then invites you to compare that with Ray Leverton's "a sporran with eggs". His description of the Kentish glory includes a red panda face behind which luxuriates the ermine mantle of a high court judge; the wings are a horse chestnut canvas on which are imprinted flurries of snow and a black marker pen wielded by a toddler. Ooh-er.

Everywhere he goes, he is assisted by local experts and Lowen writes about them, their engagements with nature in their "patch", and their difficulties and successes. He meets a hawkmoth breeder (whose wife dismisses them as "mice with wings"); this naturally elicits a digression on *The Silence of the Lambs*, while elsewhere two pupae that fail to hatch are likened to Harrison Ford frozen in carbonite by Jabba the Hutt. He visits a country house whose eight moth traps are arranged in such a pattern that at least one will be sheltered, regardless of the wind direction; one trap produces a striped hawkmoth (*Hyles livornica*) – a moth I have only seen once in the Canaries. He meets a man who needs a government licence to moth-trap in his own garden since his visitors sometimes include Fisher's estuarine moth (*Gortyna borelii*) - a Red Data Book species.

You will gather that this is writing of a lively style. There are deliciously awful puns – "the charge of the Light Brocade" - and startling verbs; thus, birds "melodise" in woodland tree-tops, while plants "tussock" the ground. Yet the attraction of the book does not lie in style alone. There is plenty of information embedded throughout the text - how the silver Y (*Autographa gamma*) exhibits an unusual pattern of migration; the continuing saga of rare burnets (*Zygaena* spp.) in the Highlands and Islands; why the gypsy moth (*Lymantria dispar*) is the only moth in the IUCN list of "world's hundred worst invasive alien species" and whether it can re-colonise Britain. The book features mothing in numerous habitats across Britain and is approximately in seasonal order throughout the year. Moths are encountered in woodland, on heather moors, on chalk downland, in marshes, on sea cliffs, in the Brecklands, and on the shingle beaches of Dungeness. The rise of "twitching" amongst dedicated lepidopterists is discussed, and we are introduced to "fridge-ticking" where rare catches are potted and placed in cold storage until other enthusiasts can arrive to see them. This is in stark contrast to an incident recounted elsewhere in the book where a rare moth was seen sitting on a trap by a friend of the trap owner. Knowing how much the trapper had wanted to see this moth, and fearing it would fly away before he could alert him, the passing friend potted it. The trap owner refused to even look at it; it was not "his".

Much Ado About Mothing is not heavily-illustrated, but the cluster of colour photos in the centre of the book show the author in various guises (including walking with five moth traps suspended from his shoulders), his daughter and various co-conspirators. However, actual moths shown do include some very choice examples. It is a quirky and unusual book, relentlessly enthusiastic and optimistic, which has attracted an appreciative readership, to which I belong.

Tony Payne

The Glasgow Naturalist (2023) Volume 28, Part 1, 98-99

OBITUARY

Peter S. Meadows (24th March 1936 - 6th January 2023) Peter Meadows in 2005 wearing his Linnean Society tie and showing his Sitara-i-Quaid-i-Azam medal. (Photo: Raymond Stoddart)

The marine biologist Peter Meadows, who has died aged 86, will be remembered as an enthusiastic teacher especially of fieldwork, as a researcher on marine sediments, but also for a late-flowering involvement in sustainable development and community engagement in Pakistan, for which he received awards from the Pakistan government and the U.K.'s Pakistani-origin community.

When I studied Zoology at the University of Glasgow in the mid 1960s, Peter was a recently-appointed lecturer: he was an imposing figure - tall with a bushy auburn beard. We learned to address him as Mr. Meadows, not as Doctor or Professor, his appointment to the academic staff without a Ph.D. degree conferring a kind of prestige, now vanishingly rare in science.

After secondary education at Westminster School in London, Peter initially studied medicine at Cambridge, but then switched to natural sciences, specialising in Zoology. A short period in Aberdeen studying growth in dogfish was followed by three years in Bangor, north Wales, investigating the settling behaviour of larval barnacles with Dennis Crisp. This work impressed the most eminent British marine biologist of the time, Regius Professor of Zoology at Glasgow, Maurice Yonge, who appointed Peter to a permanent lectureship at the University of Glasgow in 1963, aged 27. He remained there until "retirement" in 2001. Like many dedicated academics, formal retirement made little difference to Peter's activities, and he remained an honorary lecturer until his death.

In undergraduate teaching, Peter was the driving force behind the creation of a second-year course in Marine Science, and later of a new degree course in Aquatic Bioscience which uniquely combined the University's access to the Clyde estuary, including the University Marine Biological Station Millport (UMBSM), with the field station at Rowardennan on Loch Lomond and its abundant freshwater resources. These courses were supported by Peter's successful textbook, *An Introduction to Marine Science* (1978, second edition 1988), co-written with his second wife Jan Campbell, who also collaborated on much of his 1970s and 1980s research. Peter also organised evening classes in marine science, and GNHS member Morag McKinnon tells of how inspirational these were for her.

Peter was also an assiduous supervisor of research students, 30 of whom achieved Ph.D. degrees. One of the first, Robin Bruce, recalls with gratitude the huge efforts Peter made to secure funding for his project on the reef fishes of Aldabra in the Indian Ocean. Many of the students came from North Africa and the Middle East where Peter had developed links. He ensured that these students gained not only from research training but also from becoming fluent in English: his laboratory door bore the warning "Only English to be spoken here". One of these students was Azra Tufail, who became Peter's third wife and collaborator in his later work.

From the 1960s, Peter had collaborated with the University of Strathclyde microbiologist John Anderson on the properties of marine sediments, with Peter's contributions focusing on the ways in which burrowing animals altered these properties. This culminated in a Zoological Society of London symposium on the *Environmental Impact of Burrowing Animals and Animal Burrows* (1990) and this unusual combination of zoology and engineering led to the award of a Geotechnical Medal by the U.K.'s Institute of Civil Engineers in 1995 to Peter and colleagues. The field of so-called "ecosystem engineering" by animals has now become an important feature of modern ecology.

Peter's scientific research output is substantial, over 150 papers in refereed journals, much of the early work being on the small burrowing amphipod, *Corophium volutator*. Fellow amphipod enthusiast Geoff Moore keeps an autograph album for visiting colleagues to sign: Peter's reads "Peter Meadows: a great lover of *Corophium volutator*, the only real animal apart from German shepherds". Peter's main involvement with GNHS was to edit *The Glasgow Naturalist* along with Azra for the four parts of volume 24 (2004-07). He also gave talks to the Society and published several papers in the journal. One of these brought his marine science and dog-loving together. Meadows (2011) describes an incident where his dogs sniffed around some stranded lion's mane jellyfish on Kames Bay beach, Isle of Cumbrae, and became (temporarily) very sick.

It is his later activities in Pakistan, in combination with Azra, that are more likely to resonate with a wider public. The first major output was an interdisciplinary symposium on the *Indus River: Biodiversity, Resources and Humankind,* published in 1999. This was followed by a large-scale expedition, funded by the Royal Geographical Society and supported by the Linnean Society in 1999 to the Chitral Valley in the Hindu Kush mountains of Pakistan. These areas are highly vulnerable to earthquakes and to flooding (as is now all too well known, after the disastrous floods of late 2022), and the community development and education work done by Peter and Azra and their collaborator, architect Yasmeen Lari, includes a manual and workshops on disaster preparedness and food security. Their efforts have been recognised through the award to Peter in 2005, for services to education and the environment, of the Sitara-i-Quaid-i-Azam (= star of the great leader Mohammad Ali Jinnah) medal, one of the highest awards that the Government of Pakistan can award to a foreigner; and then to Peter and Azra jointly the U.K. Pakistan Society's annual medal in 2013 for contributions to the public understanding of Pakistan in the UK. This work has been so influential that Peter's Wikipedia entry currently describes him as a political scientist!

As well as science, Peter had a keen interest in music and the visual arts, was active in the West of Scotland SCUBA diving community, was a regular runner until his back problems proved too much (these started early; undergraduates recall him lecturing supine on a table, rather than cancel a lecture because of back-pain) and more recently Parkinson's disease took hold. Peter was married three times and is survived by his devoted wife Azra, and a daughter and son from his first marriage.

(Peter S. Meadows: born 24th March 1936; died 6th January 2023)

REFERENCE

Meadows, P.S. (2011). The dangers of lion's mane jellyfish *Cyanea capillata* (Linnaeus) to domestic dogs *Canis lupus familiaris. The Glasgow Naturalist* 25(3), 29-31.

Roger Downie

The Glasgow Naturalist (2023) Volume 28, Part 1, 100-107

PhotoSCENE 2022-23

PhotoSCENE Natural History Photographic Competition

The annual PhotoSCENE competition is sponsored by Glasgow Natural History Society and the University of Glasgow School of Biodiversity, One Health and Veterinary Medicine. It aims to promote interest in Natural History and the work of SCENE (Scottish Centre for Ecology and the Natural Environment, the University's field station at Rowardennan, Loch Lomond), promote linkage between the School and the Society, and provide pictures for publicity. All entrants are thanked for making the effort to enter the competition. Prizes totalling £800 per year have been awarded at the Society's photographic nights. Since the first competition in 2011, and together with talks from members, the competition has provided us with an interesting photographic evening each February. This year there were 139 entries from 35 people. 17 people.

D.C. Palmar

Overall Winner:

David Stone - Mountain hare (*Lepus timidus*), Berry Burn wind farm, Moray, Scotland, 26th April 2022.

Other prize winners:

These include the photograph by Sarah Longrigg, which was the Second Prize winner and features on the front cover, and that by Magdalena Butowska, which was highly commended and features on the back cover. Information on these photographs is provided on the inside front cover. The other prize winners and highly commended entries are shown below.

Third equal Prize winners:

Mark Pitt - Wood warbler (*Phylloscopus sibilatrix*), SCENE (Scottish Centre for Ecology and the Natural Environment), Rowardennan, Loch Lomond, Scotland, April 2022.

Dan McMeel - Common frogs (*Rana temporaria*), Mugdock, Stirlingshire, Scotland, March 2021.

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Highly commended entries:

Pauline Wood - Scorpion fly (*Panorpa* sp.), Neilston, East Renfrewshire, Scotland, June 2022.

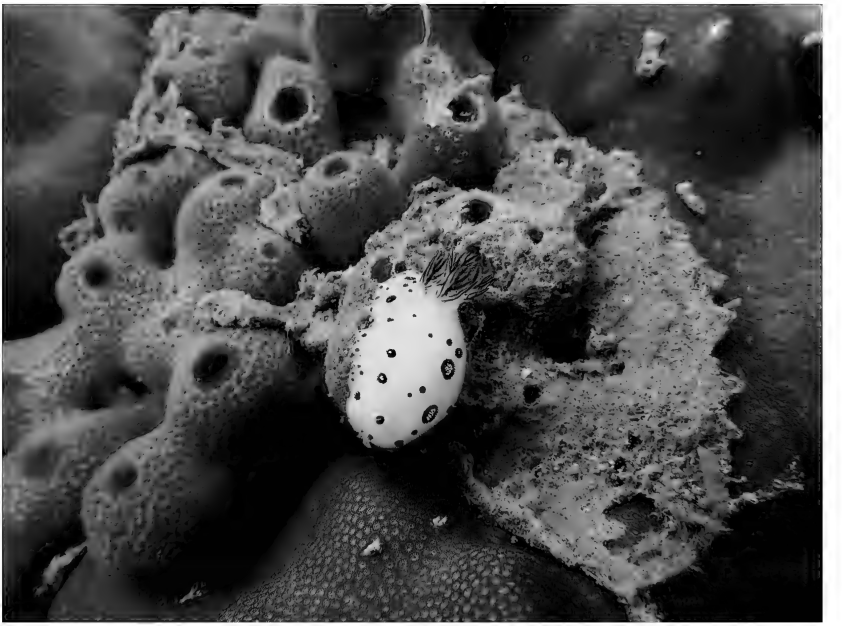
Olivia Murphy - Robin (*Erithacus rubecula*), Poolewe, Wester Ross, Scotland, September 2022.

Martha Lowe - Grey squirrel (*Sciurus carolinensis*), Kelvingrove Park, Glasgow, Scotland, 5th May 2022.

Kate Morrison - Redwing (*Turdus iliacus*), Skálanes Nature and Heritage Centre, Seyðisfjörður, Iceland, 6th July 2022.

Richard Sutcliffe - Small tortoiseshell (*Aglais urticae*) feeding on stonecrop (*Sedum spectabile*), Bearsden, East Dunbartonshire, Scotland, 14th September 2022.

Amy-Jo Randalls - Puffin (*Fratercula arctica*), Isle of May, Firth of Forth, Scotland, 23rd July 2021.



Ashlynn White - Spotted nudibranch (*Jorunna funebris*) on unidentified blue sponge (Porifera), Koh Phangan, Gulf of Thailand, July 2022.

Scott Shanks - Tree wasp (*Dolichovespula sylvestris*) on creeping thistle (*Cirsium arvense*), Fairlie, Ayrshire, Scotland, August 2021.

Kirsty Dunning - "Moon thrush" (*Turdus* sp.), Pollok Country Park, Glasgow, Scotland.

Leoni De Wert - Patchwork leaf-cutter bee (*Megachile centuncularis*), Cambuslang, South Lanarkshire, Scotland, 29th July 2022.

Jaime Villacampa - Snipe flies (*Rhagio* sp.) mating, Merrick, Dumfries & Galloway, Scotland, June 2021.

The Glasgow Naturalist (2023) Volume 28, Part 1, 108-110

PROCEEDINGS 2021

Throughout 2021, due to the Coronavirus (COVID-19) pandemic, all indoor meetings were held online via Zoom. For each meeting lecturers' names and the title of their lectures are given.

January 12th
Lecture 1: "Local nature sites in South Lanarkshire" from Louisa Maddison. Lecture 2: "Eider on the Clyde" from Chris Waltho.

February 9th
Photographic Night. Darren O'Brien presented the results of the annual PhotoSCENE competition.

March 9th
Annual General Meeting preceded by Lecture: "The arctic-alpine flora of Ben Lawers: forty years of monitoring" from Dan Watson.

April 13th
Lecture: "Conserving Scotland's pollinators: from high-rise to hay meadows" from Apithanny Bourne.

May 11th
Lecture: "Brownfields and biodiversity" from Scott Shanks.

August 10th
Summer Social dinner held at The Botany, preceded by a visit to the North Kelvin meadow.

September 14th
Lecture: "Why did the hedgehog cross the road?" from Hugh Warwick.

October 12th
Lecture 1: "Project Splatter': driving our understanding of U.K. roadkill patterns through citizen science" from Sarah Raymond. Lecture 2: "Wee Forests: A tiny but powerful solution to Glasgow's climate emergency" from Kieran Dick-Doyle.

November 9th
Lecture: "Regeneration: Lessons in landscape-scale environmental restoration from Mar Lodge Estate" from Andrew Painting.

December 7th
Christmas Social dinner at The Botany.

December 14th
Lecture: "New Guinean begonias and their Glasgow connection" from Hannah Wilson.

Excursions
We held eleven of our own excursions, two joint excursions with the Clyde and Argyll Fungus Group and one weekend excursion.

Officers and Council elected at the 2021 AGM
President
Vacant

Vice Presidents
Chris McInerny
Tony Payne

General Secretary
Alison Park

Assistant Secretary
Lyn Dunachie

Treasurer
Susan Futter

Winter Syllabus
Roger Downie

Excursions
Alison Moss

Membership Secretary
Richard Weddle

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Newsletter Editor
David Palmar

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Richard Weddle: Bio-recording
Alison Moss: Botany
Ann Ainsworth: Geology
David Palmar: Photography
Myles O'Reilly: Zoology

Social Secretary
Mary Child

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Bob Gray
Laura Allen
Robyn Haggard
Kirsty Kennedy-Wylie

Janet Palmar
Scott Shanks

BLB Executive
Chair: Barbara Mable
Secretary: Alison Park
Treasurer: Susan Futter
Scientific Advisor Tony Payne
Technical advisor: Richard Weddle
Financial Advisor: Bob Gray

PROCEEDINGS 2022

For each meeting lecturers' names and the title of their lectures are given. At the start of the year the Coronavirus (COVID-19) pandemic required that indoor meetings were held online. Later on, face-to-face meetings took place at the venues given below. In some cases, the option to attend either in person or online was made available.

January 11th
Lecture: "Research into the population of Exmoor ponies at Cochno Farm" from Deborah Davy. Virtual meeting via Zoom.

February 8th
Photographic night: Darren O'Brien presented the results of the annual PhotoSCENE competition. Virtual meeting via Zoom.

March 8th
Annual General Meeting preceded by Lecture: "Bioblitzing in Trinidad and Tobago – from Tucker Valley to the backyard" from Mike Rutherford. Virtual meeting via Zoom.

March 11th
Lecture: "Peatlands - what have they ever done for us?" from Clifford Bain jointly with Hamilton Natural History Society and Paisley Natural History Society. Hamilton Old Parish Church Hall.

April 12th
Lecture: "Dragonflies of Scotland, and the work of the British Dragonfly Society across the UK" from Andrea Hudspeth. Virtual meeting via Zoom.

May 10th
Lecture: "Seagrass in Scotland: challenges and opportunities" from Richard Lilley. Virtual meeting via Zoom.

June 4th and 5th
Conference: "Brownfield Biodiversity". Day 1: Graham Kerr Building with option of virtual attendance. Day 2: Excursions to two brownfield Local Nature Reserves in Glasgow.

June 14th
Summer Social dinner held at Elenas, preceded by a visit to Yorkhill Green Spaces led by Scott Shanks.

September 13th
Lecture: "E.S. Russell - Glasgow graduate, pioneer of fisheries management and philosopher of biology" from Roger Downie and Robin Bruce. Boyd Orr Building.

October 11th
Lecture: "Twisted in an extremity of despair: mangroves in the past and future" from Mark Huxham. Boyd Orr Building.

November 2nd
Blodwen Lloyd Binns Lecture: "Evolvability and the function of inheritance" from Kevin Laland. Graham Kerr Building with option of virtual attendance.

November 8th
Lecture: "The GALLANT (Glasgow as a Living Lab Accelerating Novel Transformation) project" from Jaime Toney. Boyd Orr Building.

November 10th
Lecture: "Tree management at the Royal Botanic Garden, Edinburgh" from William Hinchliffe jointly with Glasgow Treelovers and Friends of Glasgow Botanic Gardens. Boyd Orr Building.

December 6th
Christmas Social dinner at The Botany.

December 13th
Lecture: "Mycalesina butterflies as a model system for evolutionary biology" from Oskar Brattstrom. Boyd Orr Building.

Excursions
There were ten of our own excursions and two joint excursions with the Clyde and Argyll Fungus Group.

Officers and Council elected at the 2022 AGM

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The Glasgow Naturalist

Information for Contributors

1. *The Glasgow Naturalist* publishes full papers, short notes and book reviews. All articles are peer reviewed by a minimum of two reviewers. The subject matter of papers and short notes should concern the natural history of Scotland in all its aspects, including historical treatments of natural historians. Details of the journal can be found at: www.gnhs.org.uk/gnat.html

2. Full papers should not normally exceed 20 printed pages. They should be headed by the title and author, postal and e-mail addresses. Any references cited should be listed in alphabetical order under the heading References. All papers must start with a short abstract of up to 200 words, which should summarise the work. The text should normally be divided into sections with sub-headings such as Introduction, Methods, Results, Discussion, Acknowledgements and References.

3. Short notes should not normally exceed two printed pages. They should be headed by the title and author's name, postal and e-mail address. Any references cited should be listed in alphabetical order under the heading References. There should be no other sub-headings. Any acknowledgements should be given as a sentence before the references. Short notes may cover, for example, new locations for a species, rediscoveries of old records, ringed birds recovered, occurrences known to be rare or unusual, interesting localities not usually visited by naturalists, and preliminary observations designed to stimulate more general interest.

4. References should be given in full according to the following style:

Pennie, I.D. (1951). Distribution of capercaillie in Scotland. *Scottish Naturalist* 63, 4-17.

O'Reilly, M., Nowacki, S. & Gerrie, E. (2018). New records of the white-banded grapple-worm. *The Glasgow Naturalist* 26(4), 96-97.

Wheeler, A. (1975). *Fishes of the World*. Ferndale Editions, London.

Smith, C.W., Aptroot, A., Coppins, B.J., Fletcher, A., Gilbert, O.L., James, P.W. & Wolseley, P.A. (2009). *The Lichens of Great Britain and Ireland*. (2nd edition). The British Lichen Society, London.

Grist, N.R. & Bell, E.J. (1996). Enteroviruses. In: Weatherall, D.J. (Editor). *Oxford Textbook of Medicine*, pp. 381-390. Oxford University Press, Oxford.

References with more than six authors: name the first six authors, then add "*et al.*"

5. References should be cited in the text as follows:

Single author: Pennie (1915)… (Pennie, 1915). Two authors: Grist & Bell (1996)… (Grist & Bell, 1996). More than two authors: Smith *et al.* (2009)… (Smith *et al.*, 2009). Multiple citations: (Pennie, 1915; Grist & Bell, 1996). Same author(s), publications in different years: (MacGillivray, 1840, 1855).

6. An organism's genus and species names should be given in italics when first mentioned. Thereafter only the common name is required. Please use lower case initial letters for all common names, e.g. wood avens, blackbird, unless the common name includes a normally capitalised proper name, e.g. Kemp's ridley turtle. The nomenclature of vascular plants should follow Stace, C.A. (2019). *The New Flora of the British Isles*. (4th edition). C&M Floristics, Stowmarket. Normal rules of zoological nomenclature apply. When stating distribution, it may be appropriate to give information by vice-county.

7. All articles must be prepared as a word-processed document in A4 format, double-spaced throughout, with margins of 25 mm, and 12 point Times New Roman font. Tables and the legends to figures should be typed on separate pages at the end of the manuscript.

8. Tables are numbered in arabic numerals, e.g. Table 1. These should be double-spaced on separate pages with a title and short explanatory paragraph underneath.

9. Line drawings and photographs are numbered in sequence in arabic numerals, e.g. Fig. 1. If an illustration has more than one part, each should be identified as, e.g. 9A, B etc. They should be supplied as digital images (minimum resolution 300 dpi in tif or jpeg format) either in separate files or on separate pages at the end of the manuscript: they should not be embedded in the text. A metric scale must be inserted in photomicrographs etc. Legends for illustrations should be typed on a separate page.

10. Articles should be submitted by e-mail to the Editor: Dr Iain Wilkie Editor@gnhs.org.uk

11. When submitting an article, authors should assure the Editor explicitly that all illustrations, including maps, do not infringe copyright law. **Articles will not be considered for publication without this assurance.**

12. When the article is accepted for publication, the author should return the corrected manuscript to the Editor as soon as possible. Final proofs will be e-mailed to authors and should be returned by e-mail as soon as possible. **Alterations at this stage should be kept to the correction of typographical or formatting errors. More extensive alterations may be charged to the author.**

13. A copy of the published article will be sent to the corresponding author as a pdf file. Offprints will not be supplied.

14. All submissions are liable to assessment by the Editor for ethical considerations, and publication may be refused on the recommendation of the Editorial Committee.

15. Authors must sign a publishing agreement giving the GNHS copyright for articles published in *The Glasgow Naturalist*. This is standard procedure for publishing in most scientific journals, and allows the article to be archived at the Biodiversity Heritage Library www.biodiversitylibrary.org/bibliography/38981#/summary